Deliverable Report

Extending Design Thinking with Emerging Digital Technologies

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(Integration of emerging new technologies into education and training)

Supplement to Deliverable 5.3: Report on 2nd and 3rd Year Implementations (Initial Report) Appendices A-S

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Abbreviations

DT	Design Thinking
ChoiCo	Choices with Consequences
MaLT2	Machine Lab Turtleworlds 2
SorBET	Sorting Based on Educational Technology
GearsBot	Generic Educational Autonomous Robotics Simulator
VRobotics	Virtual Robotics
LNU	Linnaeus University
NKUA	National and Kapodistrian University of Athens
NTNU	Norges Teknisk-Naturvitenskapelige Universitet
SIMPLE	SIMPLE - SME
OU	Open University
TCD	Trinity College Dublin
UGent	University Gent

Appendix A

JEWELRY AND MORE- DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Jewelry and more

AUTHOR(S):

NKUA

ISSUE:

Personal items (such as jewelry, key chains, etc.) can get even more personal and special if the person who designs them has thought carefully about the preferences and the desires of the users. The goal is for students to explore and think carefully about what personal items they will make in order to appeal to more people.

FINAL STUDENT PRODUCTION:

Small objects, printed on a 3d printer that many people will like and use.

TECHNOLOGIES TO BE USED:

✓ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ✓ nQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Mathematics	• Use the mathematical properties, expressions of the 3D shapes to design the jewelry they want. • Express the relationships accordingly and combine different mathematical objects and shapes to create their design.
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• Create rapid prototypes and different versions and debate on, whether they intend to elaborate [or not] each one of them. • Test, explore and process their artifacts (digital models and 3D-printed models).
Analysis	• Collect and analyze information and define their initial idea/goal.

	• Interpret the data collected through the questionnaires, so as to define what criteria their models should fulfill. • Compare their prototypes and assess them.
Reflecting & Feedback	• Decide and plan modifications and changes reviewing their prototypes. • Taking the feedback from their peers into consideration.
21st century Skills Related	
Communication	• Collaborate for a common goal. • Make other people's ideas come true, through discussion and teamwork. Trying to fulfill the wishes of the users.
Presentation	• Present their final artifacts

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	Grade 8-9, 14-15 year old
Prior knowledge	basic knowledge of programming concepts with Logo, trigonometry, basic algebra (simple functions, algebraic expressions, etc.)
Nationality, gender, cultural background	21-25 pupils from Greece
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 8 hours divided in 2 sessions

IMPLEMENTATION DURATION: 2 weeks

SCHEDULE: 4 hours/week

SPACE

ACTIVITY TYPE: ✓ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: computer laboratory

VIRTUAL SPACE: E-class (if needed)

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 21-25 No of GROUPS : 7-8 No of TUTORS: 1 No of ASSISTANTS: 1-2

STUDENT GROUPING & INTERACTIONS

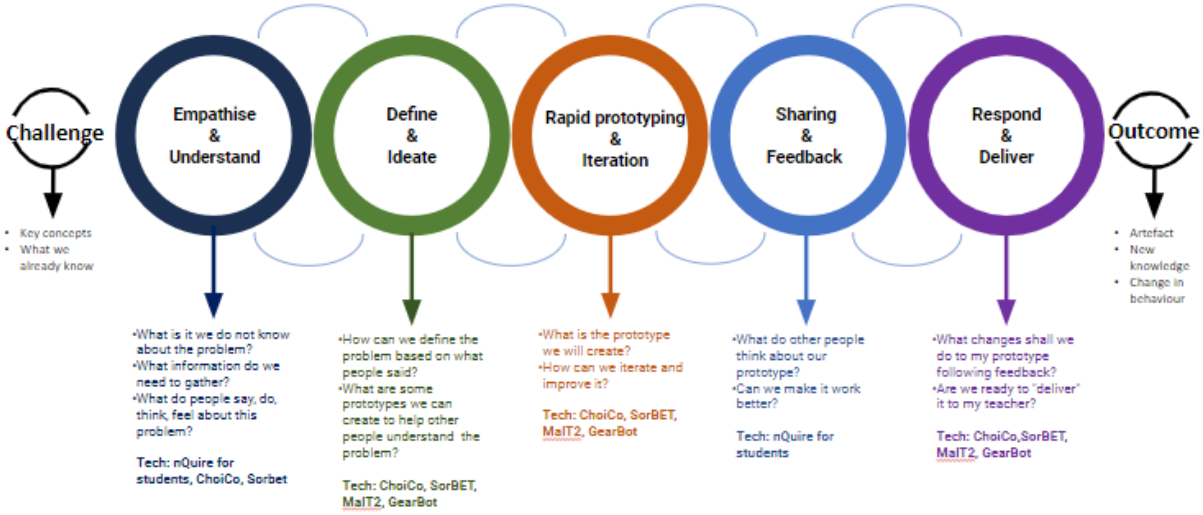
Grouping Criteria	Students' preferences, as understood by the teacher, so as to ensure better opportunities for collaboration
Organisation	Students sit in groups of 3, in the computer lab, with one computer available per group.
Roles in the group	One keyboard operator, one takes notes and one has the worksheets we give them. The roles are reversed.
Tutor(s) role(s)	Facilitator of the investigation and observer of students' actions.

TEACHING RESOURCES

Digital resources	MaLT2 microworld with basic 2D & 3D models created by the teacher, nQuire
Physical resources	3D printed MaLt2 models

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

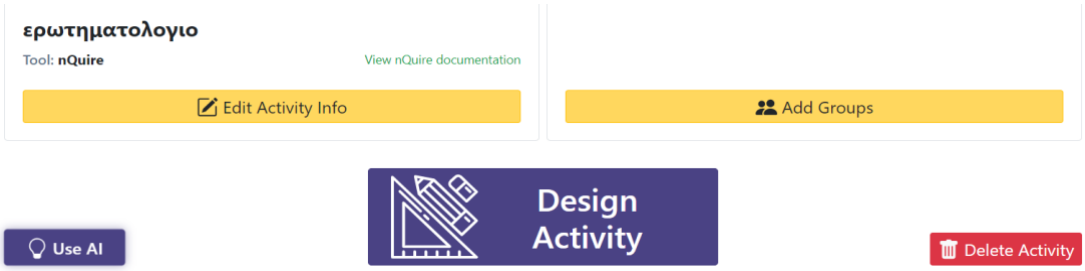
Students need to investigate what forms a piece of jewelry can have, what dimensions, what aesthetic criteria it needs to meet and then, try to imagine how it has to be constructed in order to meet them. Furthermore, they need to figure out how to use the available software to make things (jewelry or other personal items) that other people would like to use/wear.

PHASE 1: EMPATHISE & UNDERSTAND

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

In this phase the students will make a very first, rough description of their idea for construction, either with a drawing, or by finding and showing pictures, or by describing it, or by combining the above ways. They will then present it via a questionnaire in nQuire to their peers to get feedback before the first build. At first, they discuss the issue of constructing jewelry with their teacher and then with each other in their groups. They explore what kind of jewelry they want to make and what to do with it later (e.g sell it in a bazaar to collect money for a school excursion in 2 months). They research the internet, discuss their ideas, create a questionnaire and share it with their classmates.



EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ✓ nQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion and argumentation on what questions need to be included in the questionnaire
Between the groups	Interactions between the groups around these questionnaires

PHASE 2: DEFINE & IDEATE

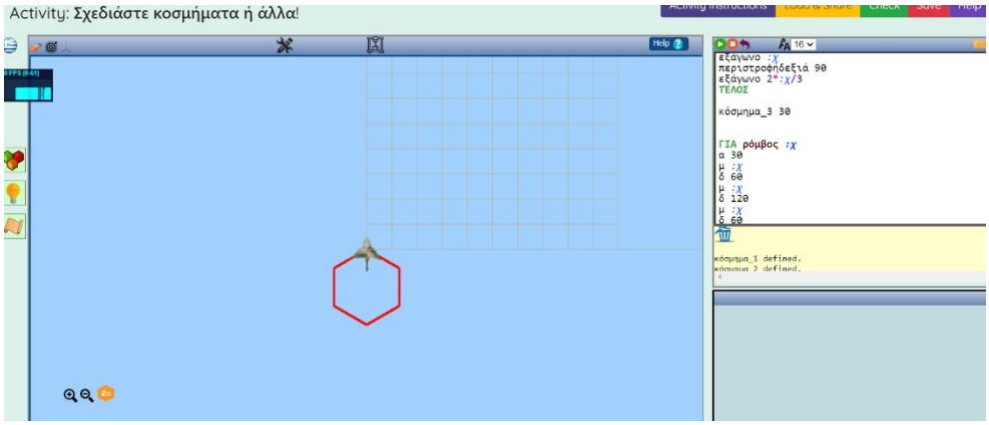
DURATION: 2 hours

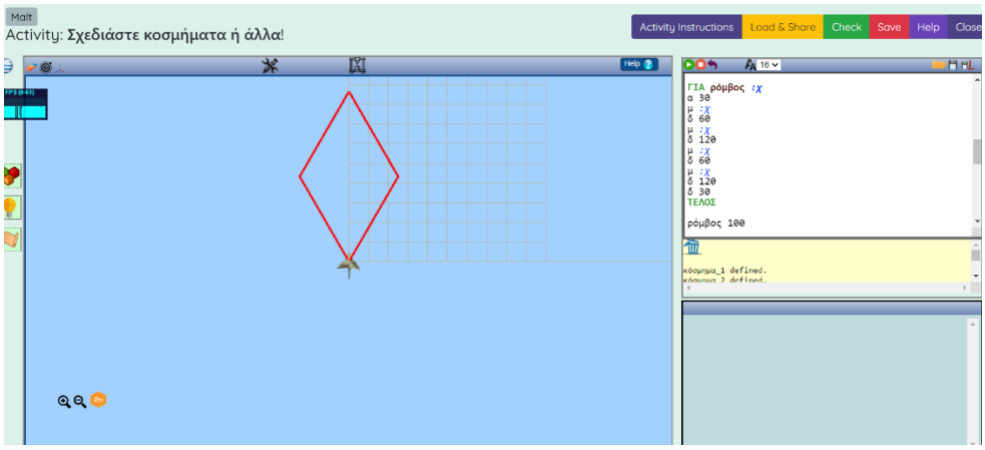
DESCRIPTION OF THE ACTIVITIES:

In order to define what jewelry they will make, each group takes time to discuss the answers collected through the nQuire questionnaires and decide what findings could be helpful and useful so that they come up with some first ideas and generate a prototype for their 3D object in MaLT2. Taking into consideration the nQuire answers, they open the MaLT2 activity that the teacher has designed on the Exten(D.T.)2 platform. There, they take some time to explore some existing procedures, brainstorming about what they could use for their own model.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Experiment with the existing procedures in MaLT2 and select the ones they want, in order to compose a 3D jewelry model, which corresponds to the criteria.

- ☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology





STUDENT CONSTRUCTIONS: First idea/design for their jewelry in MaLT2.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion, argumentation, preparation
Between the groups	Debate on their statements.

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 3 hours

DESCRIPTION OF THE ACTIVITIES:

In groups, they construct their prototypes in MaLT2, based on their choices. Then they exchange prototypes, meaning that they show other groups what they have designed. This is a first, small, cycle of feedback so that each group decides on which prototype they are going to print. They debate with other students on, to what extent these prototypes are close to what they had agreed on, during the 'ideate' phase, and how close they are to the needs and desires expressed through the questionnaires.

This phase is interrupted so that, in the meantime (one week), the constructions of the students can be printed.

In the beginning of the following session, these constructions are presented to the students. Each group receives feedback, later, so as to continue to work on making their digital models even better. They are expected to be active by adopting a "maker" culture.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Students will use Logo by running programs with their new ideas. Manipulating, dynamically, the model in MaLT2, gives them the opportunity to test their ideas, in the 3D scene and decide what to improve in their design, to reach a final version of the artifact they want to create and send to print. All their prototypes stay online in the Exten(D.T.)2 platform, making it possible for the students to discuss what they have designed with the other groups. They can show their peers, online, all their previous designs and ideas, reflect on them, change them etc. They will send some of them to be printed. After seeing the printed items, they will redesign on the platform.

- MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENTS 'CONSTRUCTIONS: MaLT2 3D models and printed models

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Making and editing logo code.
Between the groups	Exchanging prototypes, debating on these prototypes.

PHASE 4: SHARING & FEEDBACK

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

Students have shown the (digital) prototypes (through the platform) to their families and friends in order to get feedback, during the week that separates the two sessions. They briefly present them (the digital and the printed ones) in the classroom too, so as to communicate their design and ideas. Each printed jewelry is placed on a desk, and other groups can approach and touch it, see it, ask questions and discuss with the constructors about it. They can also manipulate the digital artifact of each group on the platform and explore its characteristics, if they want. The groups exchange feedback on their work. Then, they vote to rank the printed jewelry. After that, each group gets together to discuss the feedback they got. They make decisions on possible modifications and changes to their models in order to produce their final artifact.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

- MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENT CONSTRUCTIONS: New versions of each MaLT2 3D model.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	They work together. They assign roles. They argue about their ideas or how to change them based on the printed model and the on-screen model.

	Exploring the codes. Discussion and argumentation. Decision on the final changes.
Between the groups	Exchanging prototypes and debating. They discuss the feedback with the other groups. Debate. They discuss each group's product and vote.

PHASE 5:RESPOND & DELIVER

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

They try to apply the modification they decided on the logo code, in groups. They discuss all group's ideas and achievements. They decide which will be the final object to be printed in the future. At the end of the school year, they will present their final products to the whole school. So, until then, they may have to prepare a brief presentation of their work and the changes they made until they reach the final version.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

- MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: Final versions of 3D models in MaLT2

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Experimentation with the logo code. Discussion on the preparation of the future presentation Reflection on the whole process
Between the groups	Discussion on each group's construction.

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Observers' notes and digital artifacts [MaLT2 codes]

APPROACH

Learning Outcome	Assessment Activity
● Use the mathematical properties, expressions of the 3D shapes to design the jewelry they want. ● Express the relationships accordingly and combine different mathematical objects and shapes to create their design.	Review of the students' codes in their final artifacts. Assessing the way they used mathematics throughout the activity, from their initial code, up to their final artifacts.

● Create rapid prototypes and different versions and debate on, whether they intend to elaborate [or not] each one of them. ● Test, explore and process their artifacts (digital models and 3D- printed models).	Observation of each group's construction progress on coding their model and also through the flow of different prototypes stored in the ExtenDT2 platform.
● Collect and analyze information and define their initial idea/goal. ● Interpret the data collected through the questionnaires so as to define what criteria their models should fulfill. ● Compare their prototypes and assess them.	Monitoring the users' ideas, wishes and needs behind each design of prototype, through targeted questions and by giving chances for reflection and discussion . By asking questions to intrigue students to discuss their actions and contributions to the process. By reminding the user-centered design principles of the whole project.
● Decide and plan modifications and changes reviewing their prototypes. ● Taking the feedback from their peers into consideration.	
● Collaborate for a common goal. ● Make other people's ideas come true, through discussion and teamwork. Trying to fulfill the wishes of the users.	
● Present their final artifacts	Through the presentation

Appendix B

EDUCATIONAL GAMES ON MAP- DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Educational games on map

AUTHOR(S):

NKUA

ISSUE:

Building educational games that use real-time map data: Google maps has become part of everyday life. People use google maps for getting directions, for finding the best route for a destination as well as getting real time traffic information. Apart from these uses, many times we use google maps just to have a better understanding of geographical data and locations on earth.

FINAL STUDENT PRODUCTION:

Digital game in ChoiCo as a serious game built on google maps and enhanced with information and parameters that students embed into the ChoiCo game. The target audience of the game would be students' choice and have to be decided before starting to implement the game.

TECHNOLOGIES TO BE USED:

☐ MaLT2 ✓ ChoiCo ☐ SorBET ☐ VRobotics ✓ nQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Computer Science	• Program with blockly environment • Use conditional commands to program the gameplay and end rules • Find bugs and resolve issues in game play rules. • Realize the production stages of a game (Computer Science in general) • Perform data handling in database, to make basic image editing
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• perform iterative design • test and debug • create rapid prototypes

	• evaluate game instances • present their final product
Analysis	• Collect and analyze information and define their initial idea/goal. • Interpret the data collected through the questionnaires, so as to define what criteria their models should fulfill. • Compare their prototypes and assess them.
Reflecting & Feedback	• Decide and plan modifications and changes reviewing their prototypes. • Taking the feedback from their peers into consideration.
21st century Skills Related	
Communication	• Make other people's ideas come true, through discussion and teamwork. Trying to fulfill the wishes of the users. • communicate within the team
Presentation	• Present their final artifacts

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	12-13 years old (7th grade)
Prior knowledge	-
Nationality, gender, cultural background	44 Greek students
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 8 school hours

IMPLEMENTATION DURATION: 4 weeks

SCHEDULE: 2 hours /week

SPACE

ACTIVITY TYPE: ✓ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: computer laboratory

VIRTUAL SPACE: e-class, nQuire platform

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 44 No of GROUPS : 20 No of TUTORS: 1 No of ASSISTANTS: 1

STUDENT GROUPING & INTERACTIONS

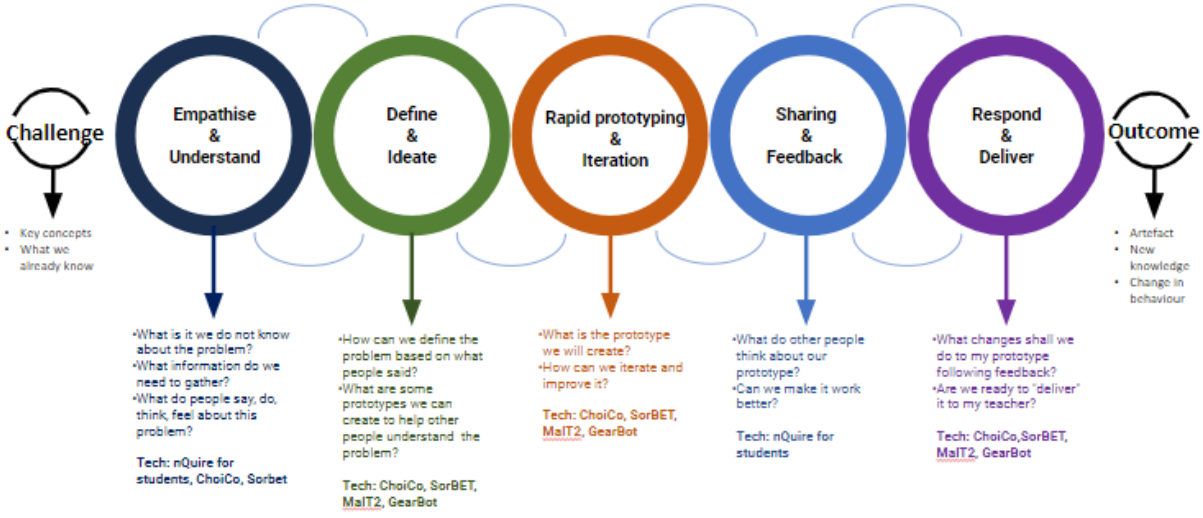
Grouping Criteria	student preferences
Organization	4 subclasses (11 students per subclass)
Roles in the group	2-3 students in a group in front of a PC
Tutor(s) role(s)	facilitator, monitoring the process

TEACHING RESOURCES

Digital resources	Predefined Choico Games as demo
Physical resources	student workbook, teacher observation notes

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathize & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

In this activity, the students firstly are introduced to the Choico platform features and play with already- made educational games on it. Google maps have been embedded in the Choico platform and students have the opportunity to exploit maps in their games. The final goal is building their own digital educational games with google maps as the main “scene” of the game. Students pretend to work in a game company that produces

digital games. Thus, they have to focus on a specific audience: their customers. They write down scenario main points and think of a small survey that may help to the game design success. The core idea of the game is that the google maps feature offers a unique game play opportunity and without that it would not be possible for the game to exist. Global maps, street view and traffic may be part of the game scenario. After the design phase, they implement the game and define the rules of the game. Subsequently, they test their own games and share them with other student groups in order to get feedback and resolve possible bugs. In a final phase, promoting their "product", they design a small advertisement for their game.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

Students play with predefined Choico games in order to familiarize with the tools and choices as a player. This will help them to think and envisage the UI and the choices for the future game. They play a simple game "Perfect Ville" that addresses sustainability issues, a game with multiple layers "Eating out" that deals with nutrition and health issues and a game with more complex UI, "Supermarket", where available choices on screen depend on game progress. They are asked to modify a game by changing some rules or some properties' values. Thus, they have a great view about what tools they have in their hands and how to use them for building their own game. In addition, they familiarize with the google map feature, discover its capabilities.

In this stage students can write down the main idea of their games and some thoughts about game flow. They have to think about the usage of google map features and how the map can provide added value to their games. They also write down 3-5 questions that they believe will be very helpful for the game development. They discuss and share their ideas and try to find a way to express the ideas on the game platform and try to use the google map feature in the most profitable way. They are also expected to use the nQuire platform to create an online survey based on their questions.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ✓ nQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: Online survey in nQuire, a Slightly modified game in ChoiCo

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion on the topic, exchange of personal experiences
Between the groups	Discussion on the topic, exchange of personal experiences

PHASE 2: DEFINE & IDEATE

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In this stage, students begin to implement their games and contemporaneously make and share the nQuire survey. They start by locating on google maps module, the area and the spots they want to include into their games. Now they have to describe and design the game in detail having a concrete

view for the whole game. They are expected to ask the teacher for more complicated or advanced features that they would like to include in the game. At this phase end, they will provide a very first game version but maybe not a playable one. Teacher can understand their target and in this phase may give specific and helpful tips. Use nQuire to build and share the survey.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Use ChoiCo in design mode to define the basic game elements (e.g. map, choice types, fields).

☐ MaLT2 ✓ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENT CONSTRUCTIONS: : A game plan (mockup) with basic elements defined

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	First ideas in group are represented in digital space. Some ideas may be rejected due to complexity or technical reasons.
Between the groups	-

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In this stage, students develop several game prototypes based on the criteria and requirements they have defined in the previous stage. In the design mode of ChoiCo, they develop their game and by switching to the play mode they test and debug it. In the middle of the session, after some internal testing, they ask students from other groups to play their game while they keep observation notes and ask for their feedback. This will lead to further redesigns and improvements. They also take into account the results of nQuire surveys and use them to make proper changes. Teacher apart from the UI, focuses on game rules in order to get students familiar with Boolean arguments and conditions. Students are expected to develop many different game prototypes.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: They are expected to use ChoiCo's database, block-based programming and map features in conjunction, in order to develop and improve their game. They are also expected to debug and fix their game algorithm, test it as players, create instructions and improve the overall gaming experience, keeping in mind the final user. Students are expected to develop many different game prototypes. They are expected to use ChoiCo's database, block-based programming and map features in conjunction, in order to develop and improve their game. They are also expected to debug and fix their game algorithm, test it as players, create instructions and improve the overall gaming experience, keeping in mind the final user.

☐ MaLT2 ✓ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENTS 'CONSTRUCTIONS: One prototype per group

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Collaborate for game development, exchange roles (developer, tester, instructor), interact with other groups to play their games
Between the groups	-

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hour

DESCRIPTION OF THE ACTIVITIES:

In this stage, students evaluating other groups' games and ask for feedback for the final version of their games. The evaluation has predefined fields- criteria (game scenario, instructions, game flow) to help classmates to define the strong and weak points.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ✓ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENT CONSTRUCTIONS: New versions of each MaLT2 3D model.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	-
Between the groups	interact with other groups to play their games

PHASE 5:RESPOND & DELIVER

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

Students create a short presentation for their game that will target their audience, i.e. young adults. This will be a short PowerPoint presentation with the first slide prepared as a game leaflet. If there is available time, they do an internal presentation in the classroom in which they show the promo material and do a demonstration of their game in ChoiCo.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

- ☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: presentation material, final game version

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Collaboration for creating and performing the presentation
Between the groups	Discussion on each group's game.

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Student worksheet, Student final games, final presentations, Teacher observation notes,

APPROACH

Group evaluation. Each group of students fills in a worksheet during all phases and delivers it to the teacher by the end of the project. The teacher will also evaluate the prototypes developed by each group throughout the activities to evaluate their learning and skill development in each DT stage.

Learning Outcome	Assessment Activity
● Program with blockly environment ● Use conditional commands to program the gameplay and end rules ● Find bugs and resolve issues in game play rules. ● Realize the production stages of a game (Computer Science in general) ● Perform data handling in database, to make basic image editing	Review of the students' codes in their final artifacts. Worksheets
● perform iterative design ● test and debug ● create rapid prototypes ● evaluate game instances ● present their final product	
● Collect and analyze information and define their initial idea/goal. ● Interpret the data collected through the questionnaires, so as to define what criteria their models should fulfill. ● Compare their prototypes and assess them.	
● Decide and plan modifications and changes reviewing their prototypes. ● Taking the feedback from their peers into consideration.	
● Make other people's ideas come true, through discussion and teamwork, trying to fulfill the wishes of the users. ● communicate within the team	

Appendix C

CYBER SECURITY WITH SORBET - DESIGN THINKING ACTIVITY PLAN YEAR 2

PROJECT TITLE:

Cyber Security with SorBET

AUTHOR(S):

NKUA

ISSUE:

The use of computers and the internet has exploded over the past decades. Along with this rise has come the emergence of online fraud and the risks posed by the internet. Students aged 12-13 have been born into information technology and should be prepared to recognise such issues in order to deal with them appropriately and to help other people who are not as technologically literate.

FINAL STUDENT PRODUCTION:

Sorting games in "SorBET" related to cyber security, specifically addressing the following fields:

- FireWall
- Strong Passwords
- Phishing

accompanied by a poster communicating it to the public.

TECHNOLOGIES TO BE USED:

☐ MaLT2 ☐ ChoiCo ☒ SorBET ☐ VRobotics ☒ nQuire

5. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Informatics	• Identify SorBET functionalities and features • Recall fundamental programming concepts, such as variables and conditionals. • Understand how camera settings integrate with game mechanics and overall gameplay experience.
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• Recall user needs and preferences for game design. • Apply user-centered design principles to game development.

Analysis	• Analyze feedback from playtesting and questionnaire responses.
21st century Skills Related	
Critical Thinking	• Decide on the categories and objects of their game and determine what deserves to be classified and which category it best fits into, based on their attitudes, their previous knowledge and the new information they have received
	• Analyze feedback from the questionnaire responses and evaluate their game design
Technology/Digital Literacy	• Apply digital literacy skills to develop a digital game prototype and use AI generators for questionnaire images
Communication	• Explain their ideas to others.
	• Express their feedback to other groups
	• Discuss different solutions to the issue at hand.
Collaboration	• Collaborate in terms of their group
	• Prepare and present as a group their final artifact by poster demonstration

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	12-13 years old
Prior knowledge	knowledge of programming with blocks, previous involvement in STEAM projects
Nationality, gender, cultural background	30 students from Greece, 17 boys and 13 girls
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 10 hours in 5 2/3-hour meetings

IMPLEMENTATION DURATION: 5 weeks

SCHEDULE: 2 hours/week

SPACE

Specify where the activity will take place

ACTIVITY TYPE: ☒ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: SCHOOL COMPUTER LABORATORY

VIRTUAL SPACE: *e-ME, extendt2 platform*

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 30 NO OF GROUPS : 10 NO OF TUTORS:1 NO OF ASSISTANTS:2

STUDENT GROUPING & INTERACTIONS

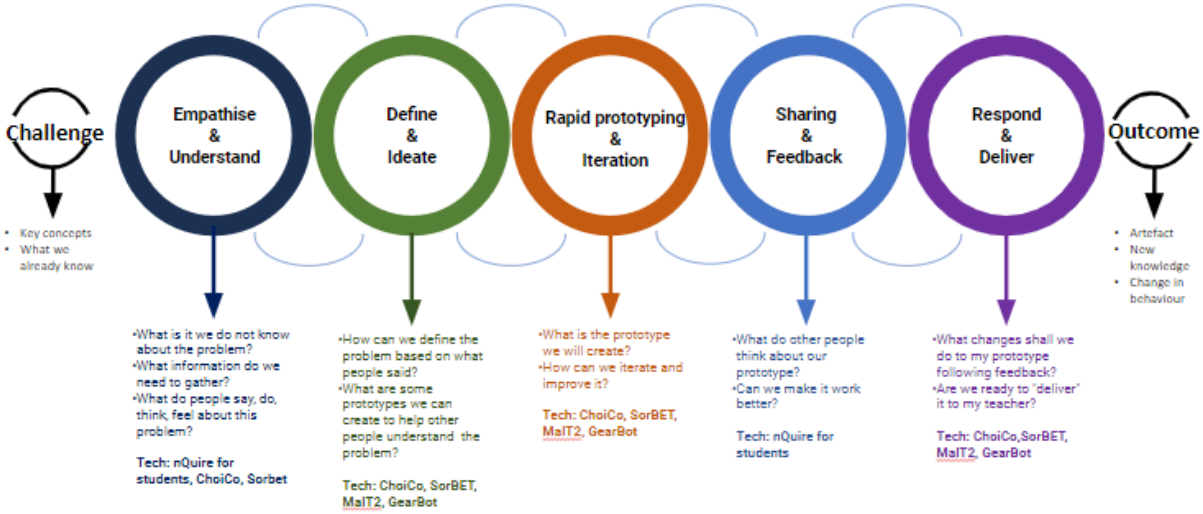
Grouping Criteria	students divided into groups - all groups are equal in terms of performance and gender
Organization	3 students per group with a PC
Roles in the group	emergent roles; role exchange in the group
Tutor(s) role(s)	Facilitator, Coordinator

TEACHING RESOURCES

Digital resources	• SorBET activities through ExtenDT2 platform • online information sources (URLs) • online quiz from "saferinternet4kids.gr" about CyberSecurity (https://saferinternet4kids.gr/quiz/poso-axiopisto-einai-auto/) • nQuire for students • digital tool for AI generated images (craiyon.com) • digital tool for poster design (https://designstudio.smallseotools.com/poster-maker/dashboard) • online qrcode generator (https://me-qr.com/)
Physical resources	blank paper to note the initial feedback they received among the class groups

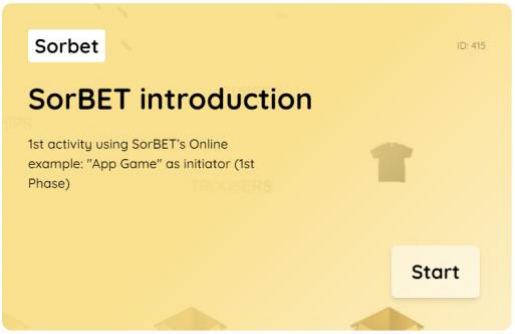
6. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

The project addresses the challenge of cybersecurity awareness and education among stakeholders aiming to explore the problem of cybersecurity threats and the importance of understanding and mitigating them. The related key concepts include common cybersecurity threats such as phishing, malware, and weak passwords, as well as cybersecurity tools and practices such as encryption, firewalls, and password strength. Students may already have some basic awareness of cybersecurity threats from their personal experiences or media exposure and can share about cases of online fraud that they or people close to them have experienced. They may not be aware of technical terms such as phishing, encryption or firewall, so they will need to do some field research on what these terms mean and how they can be handled. They may also need to learn about best practices for preventing and responding to cybersecurity incidents, including emerging threats and evolving technologies governing data protection and privacy. Additionally, students may gather feedback from peers, teachers, and other stakeholders to inform their game design. Moreover, since it is their first contact with the project technologies; some time needs to be devoted to get the students familiar with them as well as with the phases of design thinking itself. To familiarise students with the SorBET environment, the teacher chooses to assign students a ready-made activity using the EXT platform.



PHASE 1: EMPATHISE & UNDERSTAND

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

Some time at the beginning of this phase should be devoted to explaining the steps of DT and navigating the SorBET EXT environment by identifying the functionalities it offers. After realizing the usefulness of the phases of design thinking through examples of everyday problems such as designing a backpack for another person, the students will discuss the issue of internet safety. For the launch of the main part of this phase, the teacher projects 2 videos with examples of online fraud to trigger discussion around the problem. Students are expected to express their own perspectives on the topic and listen to incidents described by their classmates. An online quiz will be provided by the teacher (from saferinternet4kids.gr), so that each group can realize how easy it is to fall victim to online scams and become more aware of the problem. The teacher will have prepared the 3 main topics of Cyber Security and announce to the groups who will be involved in each one. Some topics will be explored by 2 groups. The teacher assigns groups to research each of the three topics—"Phishing," "FireWall," and "Strong Passwords"—based on the information links and helpful materials she provides. The groups will then be asked to briefly report the issues they found and the people affected to the rest of the class so that everyone can get a sense of the problem and share its views.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☒ No technology

STUDENTS' CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	• collaborate to identify and discuss the functionalities of SorBET tool • collaborate closely to research their assigned topic using the provided information links and materials • synthesize their findings and prepare a brief report to present to the rest of the class
Between the groups	• whole class discussion about the problem in the beginning, sharing their own perspectives, experiences, and opinions related to cybersecurity issues • brief group presentation of each topic to the rest of the class

PHASE 2: DEFINE & IDEATE

DURATION: 3 hours

DESCRIPTION OF THE ACTIVITIES:

In response to the problem of online safety awareness, the children in groups will design their own classification game as a stimulus for the people they expect to be the end users. In this phase the students in groups start writing down the idea for their game. Supporting material in this phase is a presentation in shared google docs that students are asked to complete. The purpose of the slides is to assist students from missing the point of their assignment, and to guide them to reflect on and determine all the necessary details before they proceed with the game design. This includes determining the purpose the game serves, who the end users will be and what they will get out of it; but also the design factors of the sorting game itself: thinking about and defining what its categories will be and what kinds of objects will be dropped for classification. On searching and using images from

the internet, the teacher will give a short introduction to the creative commons licenses so that students only seek such multimedia.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Group members will engage in discussions to evaluate different ideas and make decisions about the game design.
Between the groups	No trans-group interaction in this phase

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

During this phase students start to create their first prototype of the game. The teacher will have prepared a blank SorBET activity through the extended platform and assigned one to each group.

474	Password Strength Analyzer	Sorbet	Thursday 4 Apr 2024
473	FireWall Protector	Sorbet	Thursday 4 Apr 2024
467	ΓΝΩΡΙΜΙΑ ΜΕ ΤΟ SORBET	Sorbet	Tuesday 2 Apr 2024
420	Phishing Attack Defender	Sorbet	Wednesday 20 Mar 2024

By creating a preliminary version of their game with categories, objects, and the number of instances for each object, the students implemented the ideas they had come up with in the previous phase. They also parameterize the speed and the number of concurrent objects through the blockly code. Then, an iterative process will begin where the members of the groups test their game in Play mode using the camera feature and modify it repeatedly in order to make it as efficient as possible for this first interaction with it.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☒ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: SorBET Cyber Security related classification games

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	• work together to implement the ideas generated in the previous phase, creating categories, selecting objects, and determining the parameters for the game • parameterize the speed and number of concurrent objects using blockly code within the SorBET platform • test their game prototype in Play mode
Between the groups	play other teams' games and provide verbal comments on various aspects of the game. (emerged)

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

Students at this point, having completed their initial game, proceed to brainstorm questions that they feel are important for improving their game and receiving comprehensive feedback. In order to achieve this, some time needs to be spent familiarizing themselves with the nQuire project tool by utilizing the multiple types of responses and initial fields available. They will start creating online questionnaires being careful to describe in detail the purpose of their game so that the respondent knows exactly what it is about in order to properly assess it. For the image requested as a mission image, the students are expected to utilize an AI image generator (crayon) to create their own images that fit their topic using specific keywords. The process of designing the questions is expected to be made in an atmosphere of discussion and collaboration within the group, reminding the children to think about who will be the end user of the output. After launching the questionnaires, the links to the games from EXT platform along with the questionnaires of each group will be shared so that, during the Easter holidays, students from all classes of the high school can share their feedback. Also, a mini guide will be created by the researcher and shared to assist the process.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☒ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: nQuire online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	• Discussion about the initial information needed • Collaboration for creation of the right image via AI generated tool • Negotiation of what questions need to be included in the questionnaire
Between the groups	Different groups do not interact during this phase

PHASE 5:RESPOND & DELIVER

DURATION: 1 HOUR

DESCRIPTION OF THE ACTIVITIES

In this final phase students will receive the answers to their questionnaire, analyse them and consider what changes they need to implement to complete their game design. Finally, they will design a poster using a free online tool as a final deliverable that will promote and redirect to their game for the target audience they have set. Groups will be prompted to generate a qrcode for their game and embed it to their poster.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☒ No technology

STUDENT CONSTRUCTIONS: Final game, Poster

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	• Analyse and consider the answers to their questions for improving their game • cooperate for the design of their poster
Between the groups	presentation of each group's game and poster to the whole classroom

7. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Describe the assessment tools that will be used

APPROACH

Describe the formative and summative assessment activities. How these assess the achievement of the learning objectives as described in section 2.1.

Learning Outcome	Assessment Activity
Identify SorBET functionalities and features (Informatics)	Formative assessment activities include practice where students navigate SorBET's platform to explore its functionalities and features. Teacher and researchers observe students' interactions with the platform and provide feedback on their understanding and proficiency.
Recall fundamental programming concepts, such as variables and conditionals. (Informatics)	short coding challenges where students demonstrate their understanding of programming concepts such as variables and conditionals. Teacher can assess students' comprehension through their responses and provide targeted feedback to address any misconceptions.
Understand how camera settings integrate with game mechanics and overall gameplay experience. (Informatics)	Students engage in hands-on activities where they experiment with camera settings within the SorBET platform and observe how they impact gameplay. Teachers can facilitate discussions and provide guidance to help students understand the relationship between camera settings and game mechanics.
Recall User Needs and Preferences for Game Design	Brainstorming sessions and group discussions where students identify user needs and preferences for their game design. Teacher observe students' contributions to the discussions and provide feedback on their understanding of user-centered design principles.
Apply User-Centered Design Principles	Teacher assess students' application of user-centered design principles through their game design, questionnaire queries and interview questions
Critical Thinking	Students engage in discussions and debates about the classification of objects and categories in their game design as well as the definition of the questions. Teacher assess students' critical thinking skills by observing their reasoning, analysis, and justification for their decisions.
Technology/Digital Literacy	Students use AI generators to create images for their questionnaire and incorporate digital literacy skills in their game

	prototype development. Teacher provide guidance and support as students navigate digital tools and platforms, assessing their proficiency and problem-solving abilities.
Communication	Students present their ideas, feedback, and solutions to their peers through group discussions, presentations, and poster demonstrations. Teacher evaluate students' communication skills based on their clarity, coherence, and ability to express ideas effectively.
Collaboration	Throughout the project phases, students collaborate in their groups to design, develop, and present their game prototype. Teacher assess students' collaboration skills by observing their teamwork, communication, and contributions to group tasks.
Prepare and Present Final Artifact	Students prepare and present their final artifact, a poster demonstration of their game prototype, to their peers and teachers. Teachers assess students' presentation skills, content organization, and ability to convey key messages effectively.

Appendix D

TRAVELING WITH CHOICO DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Traveling with ChoiCo

AUTHOR(S):

NKUA

ISSUE:

This project addresses the diverse needs of travelers, including families, solo travelers, people with disabilities, elderly travelers, etc.

FINAL STUDENT PRODUCTION:

Students create a ChoiCo game for people who want to travel abroad. Each team decide on a group with specific characteristics and needs like families or low budget travelers.

TECHNOLOGIES TO BE USED:

☐ MaLT2 ☒ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

Domain Related	
Geography	Recall important landmarks in european cities
Programming	Use block programing to set the gameplay and end rules
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	Create different prototypes of ChoiCo games
Analysis	Interpret questionnaires answers to iterate their games
Reflecting & Feedback	Relate the feedback from their peers to iterations they did to the prototype

	Provide specific feedback for their peers to improve their games
21st century Skills Related	
Communication	Explain their ideas to others.
	Discuss different solutions to the issue at hand.
Presentation	Present their final artifact by demonstration

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	14 years old
Prior knowledge	-
Nationality, gender, cultural background	1 pupil is from Albania and 20 from Greece, 15 boys & 6 girls
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 9 hours divided into 5 times

IMPLEMENTATION DURATION: 5 weeks

SCHEDULE: 1-2 hours/week

SPACE

ACTIVITY TYPE: + In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: classroom

VIRTUAL SPACE: -

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS:21 NO OF GROUPS :5 NO OF TUTORS: 1 NO OF ASSISTANTS: 1

STUDENT GROUPING & INTERACTIONS

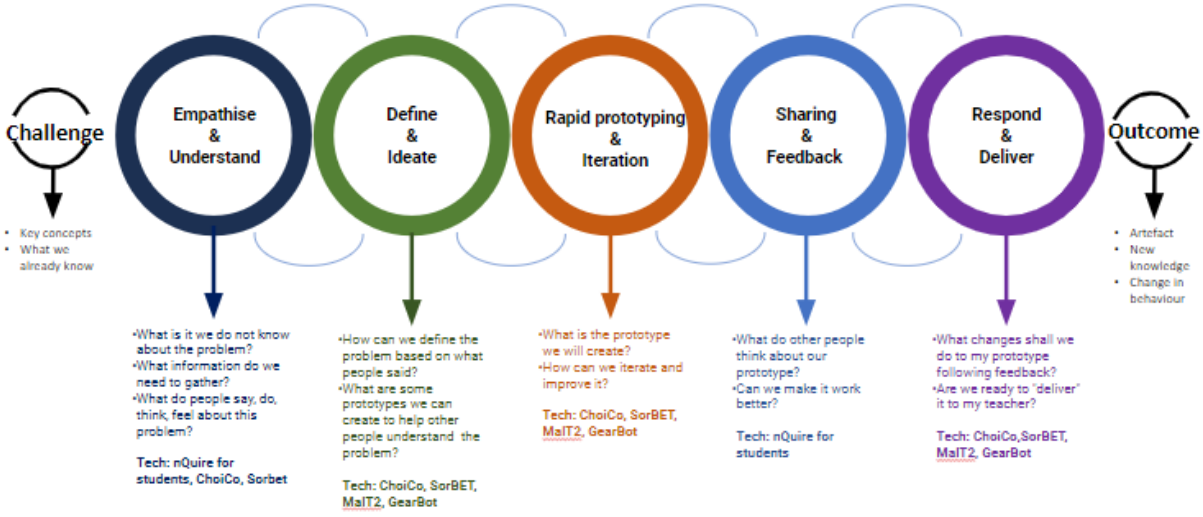
Grouping Criteria	mixed school performance, student preferences
Organization	4-5 students per group using 1 tablet per group
Roles in the group	emergent roles; role exchange in the group
Tutor(s) role(s)	intervene; monitor; facilitate; guide; observe

TEACHING RESOURCES

Digital resources	ChoiCo game - Living in Athens
Physical resources	-

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Traveling can sometimes be challenging when you have special needs or financial restrictions. Families with young children do not have the same vacation needs with youngsters or people with pets. In this project students walk in the shoes of others to design simulations that fit the needs of every special group of travelers.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In this phase students first discuss the issue with the teacher and explore the ChoiCo environment. They enter with their learner ids in the extendt2 platform and use the ChoiCo activity "Living in Athens" in order to get acknowledged with the ChoiCo games rational and functionalities. Then they brainstorm ideas on the game they are going to design, their target audience, their special needs and the place their game will refer to. At his point they are encouraged to search for information online or ask their peers.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: -

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion and argumentation on their target audience, their special needs and the place their game will refer to.
Between the groups	Different groups can interact during this phase in the context of gathering information about different places on the map

PHASE 2: DEFINE & IDEATE

DURATION:2 hour

DESCRIPTION OF THE ACTIVITIES:

In the "Define & Ideate'' phase, students experiment with the ChoiCo environment applying their initial ideas based on the information gathered in phase 1. The aim of this phase is to define the main elements of their game such as the fields of the game and the city where the choices are going to be pinned on and the general game outline.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion and argumentation on the main elements of the game, the city that the game will refer to and the audience the game will be addressed
Between the groups	Different groups do not interact during this phase

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In this phase students design in their group a range of prototypes for their game, testing them internally in their group and redesigning them until a final version is ready. While students iterate their prototypes, the teacher encourages them to think about many aspects of the player's experience by playing the game themselves often as players.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: ChoiCo games prototypes

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion and argumentation on the main elements of the game, the gameplay rules, the fields and the choices' values.
Between the groups	Different groups do not interact during this phase

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In the "Sharing & Feedback" phase students use NQuire to create missions aiming to take feedback for their prototypes. In their missions they publish their game's link for external users to play, adding 3-4

questions for their audience. Students also contribute to the other's missions leaving their own feedback for other group's games.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussions and keeping track of the feedback
Between the groups	Every student provides written feedback to every group via nQuire

PHASE 5: RESPOND & DELIVER

DURATION: 2 hour

DESCRIPTION OF THE ACTIVITIES

During this phase, students overview the answers of their missions and discuss in their teams the feedback they have received. They decide on which changes proposed by their peers they are going to implement in their games. They then prepare a demonstration of their game to the whole class. After each team presents their game, the rest of the students can pose to the group questions about their project.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussions on what parts of the feedback they received they are going to implement in order to create the final version of their game.
Between the groups	Different groups may interact during this phase, in cases where the feedback is not that compehensive

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Tutor's notes

APPROACH

Learning Outcome	Assessment Activity
Recall important landmarks in european cities	Review of the students' games
Select points on the map taking into account distances and ways of transportation in the city	Review of the students' games
Create different prototypes of ChoiCo games	Review of the students' programs in their final artifacts
Interpret questionnaires answers to iterate their games	Review of the students' final artifacts in relation with the feedback provided in their missions Oral presentation and questions during the last phase
Relate the feedback from their peers to iterations they did to the prototype.	Oral presentation and questions during the last phase
Provide specific feedback for their peers to improve their games	Students' answers in NQuire missions during the Sharing and Feedback phase
Explain their ideas to others.	Oral presentation and questions during the last phase
Discuss different solutions to the issue at hand.	
Present their final artifact by demonstration	Oral presentation and questions during the last phase

Appendix E

ENTREPRENEURSHIP WITH CHOICO - DESIGN THINKING ACTIVITY PLAN — YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Entrepreneurship with ChoiCo

AUTHOR(S):

NKUA

ISSUE:

For entrepreneurs, expanding their business, making more affordable or changing strategy include crucial decisions that affect their company's sustainability and success. In order to avoid making bad decisions, tools that simulate their various choices and their consequences may prove to be really helpful.

FINAL STUDENT PRODUCTION:

Students design a ChoiCo game that simulates the practice of an entrepreneur.

TECHNOLOGIES TO BE USED:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Entrepreneurship	• Relate to entrepreneurs practice. • Discuss risks that entrepreneurship entails. • Compare different entrepreneurship choices taking into account the risk and profit.
Programming	• Use conditional commands • Use the database

Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• Create different prototypes of ChoiCo games
Iteration	• Use their peers feedback to iterate their prototypes
Feedback	• Relate the feedback from their peers to iterations they did to the prototype • Give helpful feedback to their peers
21st century Skills Related	
Communication	• Explain their ideas to others. • Discuss different opinions
Presentation	• Present their final artifact by demonstration

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	16 years old
Prior knowledge	-
Nationality, gender, cultural background	Greek, 2 girls, 12 boys
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 12 hours divided into 6 times

IMPLEMENTATION DURATION: 6 weeks

SCHEDULE: 2 hours/week

SPACE

ACTIVITY TYPE: ✔ In person ☐ At distance ☐ Mixed

PHYSICAL SPACE: computer laboratory

VIRTUAL SPACE: -

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 14 NO OF GROUPS :1 NO OF TUTORS: 1 NO OF ASSISTANTS:1

STUDENT GROUPING & INTERACTIONS

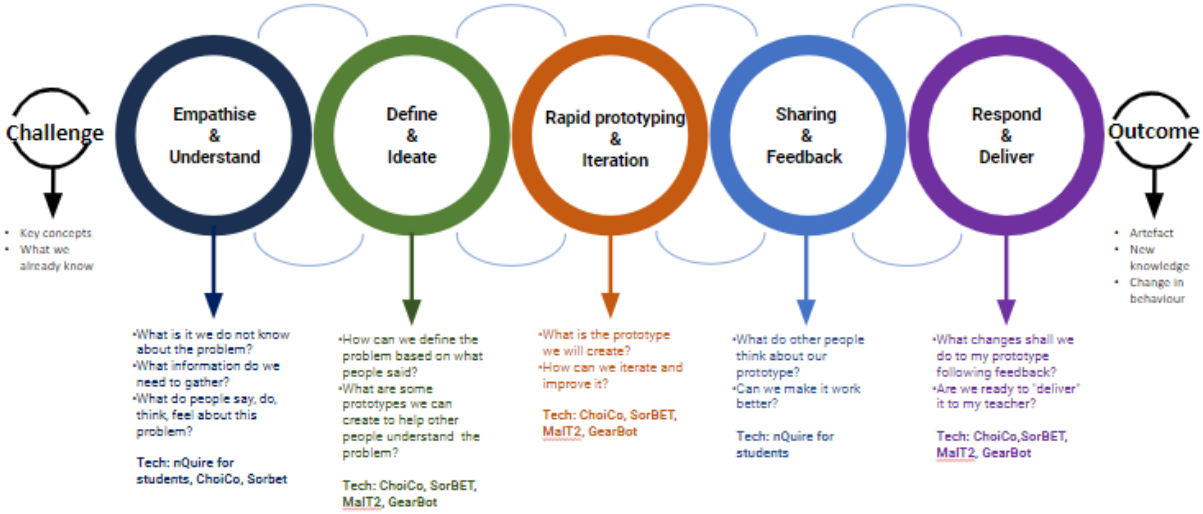
Grouping Criteria	mixed school performance, student preferences
Organization	3-4 students per group using 1 computer per group
Roles in the group	emergent roles; role exchange in the group
Tutor(s) role(s)	intervene; monitor; facilitate; guide; observe

TEACHING RESOURCES

Digital resources	ChoiCo Game - Tinkering with industry
Physical resources	notebook

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Being a successful entrepreneur requires being able to calculate the risks involved in every decision. For those who do not have enough experience this is often challenging. However, a wrong decision can cost a professional too much to be able to make their business profitable, overcoming the consequences of a bad decision. In this project students choose an area of entrepreneurship of their interest and design a game that offers the chance to young entrepreneurs to experiment with different paths and decisions without having serious damage in their business profits.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

The first session includes four parts. In the beginning the teachers introduce the students to the project and explains them the phases through which they are going to develop and iterate their game according to their audience preferences and their peers' feedback. Following the students play the ChoiCo game “Tinkering with Industry ', which has been developed by the teacher. In this game the player is a manager who can make different choices regarding how he/she manages her/his enterprise. The aim of this activity is for the students to get to know the ChoiCo environment and understand the ChoiCo games rationale. In the next phase students discuss their ideas and decide on the kind of professionals their game will be addressed to. Finally, each group creates a mission in NQuire aiming to gather information about the filed selected.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussions on what information they need in order to design their game
Between the groups	Different groups do not interact during this phase

PHASE 2: DEFINE & IDEATE

DURATION: 2 hours

DESCRIPTION:

During this phase, students begin by reviewing the answers they have provided in their missions. They take the time to analyze these responses carefully to identify the key elements of their game. Once they have a clear understanding of these main components, they open the ChoiCo environment within the ExtenDT2 platform. Here, they start experimenting with the tool's functionalities and generating ideas about various aspects of their game. This includes thinking about different fields and the game's possible choices. Through this ideation process, students collaboratively shape the initial concept and structure of their game.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussions on which information is useful by the missions' contributions
Between the groups	Groups do not interact in this phase

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 sessions- 2 hours each (total for rapid prototyping is 4 hours)

DESCRIPTION OF THE ACTIVITIES:

In this phase, students focus on creating multiple prototypes of their games. They continually refine these prototypes through repeated cycles of testing and iteration. With each cycle, they carefully assess the gameplay and identify areas that need improvement. Based on their findings, they make necessary adjustments to improve it.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: ChoiCo games prototypes

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussions on the prototypes features, decision making
Between the groups	Groups do not interact in this phase

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

This phase is like a demonstration session where all groups have one representative near the pc that the group runs their game. The rest of the group visit other PCs and play the games of other groups. After playing the game, the external user leaves their feedback to the representative of the group, who takes notes and poses questions. These representatives can change every few minutes so all students have the time to play all the other games of the class.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Students decide on how the roles they are going to have in this session and the points of feedback they want to have from external users
Between the groups	The groups discuss all games leaving feedback for the games of others and asking questions to testers about theirs

PHASE 5:RESPOND & DELIVER

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES

In this last phase students create PowerPoint presentations in which they describe their projects and they give an overview of what point of feedback they integrated in their games after the feedback session. In the end of each presentation, the rest of the class has some minutes to pose questions to the group that presents.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: PowerPoint presentations

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	-
Between the groups	Groups present their work to others and the rest of the class poses questions

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Tutor's notes, students' artifacts, students' oral presentation

APPROACH

Learning Outcome	Assessment Activity
Relate to entrepreneur's practice.	Tutor's notes Oral presentation
Discuss risks that entrepreneurship entails.	Tutor's notes Oral presentation
Compare different entrepreneurship choices taking into account the risk and profit.	Tutor's notes Students' artifacts
Use conditional commands Use the database	Students' artifacts
Create different prototypes of ChoiCo games	Students' artifacts
Use their peers feedback to iterate their prototypes	Students' artifacts
Relate the feedback from their peers to iterations they did to the prototype	Students' artifacts

	Oral presentation
Give helpful feedback to their peers	Tutor's notes
Explain their ideas to others.	Oral presentation
Discuss different opinions	Oral presentation
Present their final artifact by demonstration	Oral presentation

Appendix F

CLEANING ROBOT FOR THE SHORES - DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Cleaning Robot for the shores

AUTHOR(S):

NKUA

ISSUE:

During the summer months, coastal pollution becomes a significant problem due to the increase in human activities. Tourists often leave behind trash, including plastic bottles, bags, and other debris, which litter the shores. This not only harms marine life and disrupts ecosystems but also diminishes the natural beauty and cleanliness of the beaches. The project aims to develop effective strategies for robotic shore-cleaning operations to tackle pollution during the busy summer months.

FINAL STUDENT PRODUCTION:

In this project, students create simulations where robots move on shore maps, simulating the movements of potential robots that can be programmed to clean the indicated beaches. The simulations are created in order to be presented to municipality stakeholders who are in charge of the shores protection.

TECHNOLOGIES TO BE USED:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☐ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Mathematics	• Use the protractor to measure robot turns
Engineering	• Use motors, the gyro sensor and the distance sensor to program the robot's movements
Programming	• Use blockly programming to move the root on the indicated map • Use the repeat command to program the movements of the robot
• Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• Create different prototypes of worlds in GearsBot • Create different prototypes of robots according to the area they want to clean

	• Create different prototypes of block code to move the robot
Analysis	• Interpret their peers' answers to design criteria for the simulation they create.
Reflecting & Feedback	• Relate the feedback from their peers to iterations they did to the prototype simulation
21st century Skills Related	
Communication	• Explain their ideas to others.
	• Discuss different solutions to the issue at hand.
Presentation	• Present their final simulation to others

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	11-12 years old
Prior knowledge	basic knowledge of programming concepts
Nationality, gender, cultural background	14 Greek students
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 8 hours divided -2 sessions

IMPLEMENTATION DURATION: 2 days in 2 weeks

SCHEDULE: 6 hours the first week and 2 hour the second week

SPACE

ACTIVITY TYPE: ☒ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: classroom

VIRTUAL SPACE: -

SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 14 NO OF GROUPS : 5 NO OF TUTORS: 1 NO OF ASSISTANTS:1

STUDENT GROUPING & INTERACTIONS

Grouping Criteria	mixed school performance, student preferences, mixed gender

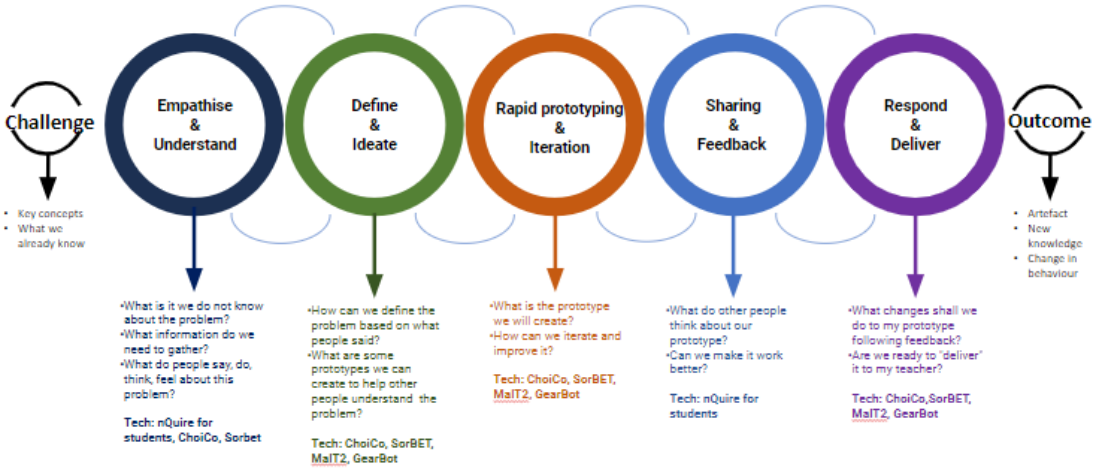
Organization	3-4 students per group using 1 computer per group
Roles in the group	emergent roles; role exchange in the group
Tutor(s) role(s)	intervene; monitor; facilitate; guide; observe

TEACHING RESOURCES

Digital resources	• GearsBot microworld with basic movement and turn programming commands • GearsBot mini guide • Tutorial video
Physical resources	-

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

During the summer, coastal pollution worsens as beaches become crowded with tourists who often leave behind trash. This litter, including plastic bottles, food wrappers, and other waste, accumulates on the shores and in the water. In this project, students create simulations where robots move on shore maps, replicating the movements of potential robots that can be programmed to clean the indicated areas. These simulations help visualize how robots can efficiently navigate and clean coastal regions littered with trash. The project aims to develop effective strategies for tackling pollution during the busy summer months using robotics. Students participating in the activity know specific places where coastal pollution is a big issue and they know how this pollution affects marine life and human health. They have previous experience with robotics applications and can recognise the potential of robots cleaning the shores. They have to find out more about which places may need a cleaning robot and why.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

In this phase the teacher informs the students of the project. Students then first use the GearsBot tool, using the activity GearsBot Cleaning Robot, created and assigned by the teacher through the ExtenDT2 platform in order to know the main features of the environment. They then discuss the issue of shore pollution with their teams and the teacher and use the Google Earth webpage to explore the map of their region and find places they think the pollution is a big issue. Finally they are tasked to form 3-4 questions to ask their peers in order to gain more understanding of the real needs regarding shore pollution. At the end of the session they visit other classrooms where they ask other students their views on the issue.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☐ NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: A list of 3-4 questions for interviewing their peers

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on what questions need to be included in the interview
Between the groups	Different groups do not interact during this phase

PHASE 2: DEFINE & IDEATE

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

In the "Define & Ideate" phase, students define (narrow down / converge) the main features of the simulation they will create based on the information gathered in phase 1. They decide on the shore their robot will be programmed to clean, the main commands they will use, whether they will add objects in their map and what kind of sensors their robots will need.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Experiment with GearBot environment using the GearsBot Cleaning Robot activity

STUDENT CONSTRUCTIONS: Notes on their peers answers in their questions

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussions on what kind of simulation they are going to make, the world they are going to create and their robot's features
Between the groups	-

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In the "Rapid prototyping & Iteration" phase students use the activity Build your own simulation to create their prototypes. They first take a screenshot of the area their robot will clean from the Google Earth environment and create their world in GearsBot. They then start to program their robot to move on the world they will have created. They improve their robots using the Robot configuration tool to adjust their robot in their world so that it moves in a desirable way.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Prototypes of GearsBot simulations

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion on the way the groups are going to iterate the program that moves their robot
Between the groups	-

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hour

DESCRIPTION OF THE ACTIVITIES:

Students finalize their simulations and show them to other groups. Other groups comment orally on how realistic are the scenarios simulated by the simulations. For example, a student who knows the shore represented in a simulation can comment on the size of the robot moving on the shore or the places there that may need to be cleaned. The groups gather their peers' oral comments and suggestions and integrate them or not in their prototypes. They are encouraged to evaluate all suggestions and take notes on the reasons why a suggestion is integrated in the simulation and why another one is not.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: -

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Students discuss the feedback given by their peers
Between the groups	Students view and discuss other groups' simulations and give their feedback.

PHASE 5:RESPOND & DELIVER

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

Students integrate in their simulations any useful feedback received by their peers in the previous phase. They then create posters to present their project to others. In their presentations they are encouraged to explain the problem their project addresses and for who and what purpose they designed this specific simulation. They also refer to the feedback received by their peers and what changes they made based on their peers' comments.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Digital posters

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion on what elements of their project need to be presented and how
Between the groups	Groups present their posters and projects to others

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

The teachers evaluates students using:

- teachers notes
- students' presentations
- students' prototypes

APPROACH

Describe the formative and summative assessment activities. How these assess the achievement of the learning objectives as described in section 2.1.

Learning Outcome	Assessment Activity
Use the protractor to measure robot turns	Teachers notes Review of the students' programs in their final artifacts
Use motors, the gyro sensor and the distance sensor to program the robot's movements	Review of the students' programs in their final artifacts
Use block programming to move the robot on the indicated map	Review of the students' programs in their final artifacts Review of students' prototypes evolution through the Load & Share option

Use the repeat command to program the movements of the robot	Review of the students' programs in their final artifacts Review of students' prototypes evolution through the Load & Share option
Create different prototypes of worlds in GearsBot	Review of the students' programs in their final artifacts Teachers notes Review of students' prototypes evolution through the Load & Share option
Create different prototypes of robots according to the area they want to clean	Review of the students' programs in their final artifacts Review of students' prototypes evolution through the Load & Share option
Create different prototypes of block code to move the robot	Review of the students' programs in their final artifacts Review of students' prototypes evolution through the Load & Share option
Interpret their peers' answers to design criteria for the simulation they create.	Review of students' prototypes evolution through the Load & Share option Teacher's notes on students' presentations

Appendix G

PERSONALIZED ITEMS DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Personalized items

AUTHOR(S):

NKUA

ISSUE:

Designing products according to the needs and preferences of the people who use them is an important issue in commerce. We often see shoes, key rings or other items personalized with the owner's name or other favorite logo. This emerged from discussions with people in the students' environment about what they would like to have as such personalized items.

FINAL STUDENT PRODUCTION:

A small 3D-object designed by the students using a solid, such as a quadrilateral or a cylinder. The object will be printed.

TECHNOLOGIES TO BE USED:

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics + NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

Domain Related	
Mathematics	• Use mathematical expressions, properties and relationships of 3D shapes to build the objects they want to. • Combine different mathematical objects to achieve their designs.
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• Create 3D-objects as rapid prototypes and debate on elaborating them or not. • Test their constructions (digital models in MaLT2 and 3D printouts).

Analysis	• Analyze information and define their goal. • Interpret the answers of the questionnaires in order to define the design criteria for their models. • Compare their prototypes.
Reflecting & Feedback	• Plan their actions in order to review these prototypes. • Revise their plans based on their decisions and the feedback from their peers.
21st century Skills Related	
Communication	• Collaborate for a certain goal. • Make other people's ideas come true, through discussion.
Presentation	• Present their final artifacts by presentation and demonstration.

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	Grade 10, 15-16 year old
Prior knowledge	basic knowledge of programming concepts with Logo, stereometry
Nationality, gender, cultural background	5 pupils from Greece
Language	Greek
Special needs and abilities	-

TIME

ACTIVITY DURATION: 8 hours divided into 4 times

IMPLEMENTATION DURATION: 3 weeks

SCHEDULE: 2 hours-1st week, 2 hours-2nd week, 4 hours-3rd week in 2 times

SPACE

ACTIVITY TYPE: + In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Computer Laboratory

VIRTUAL SPACE: E-class

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: **5** No of GROUPS : **2** No of TUTORS: **1** No of ASSISTANTS: **1**

STUDENT GROUPING & INTERACTIONS

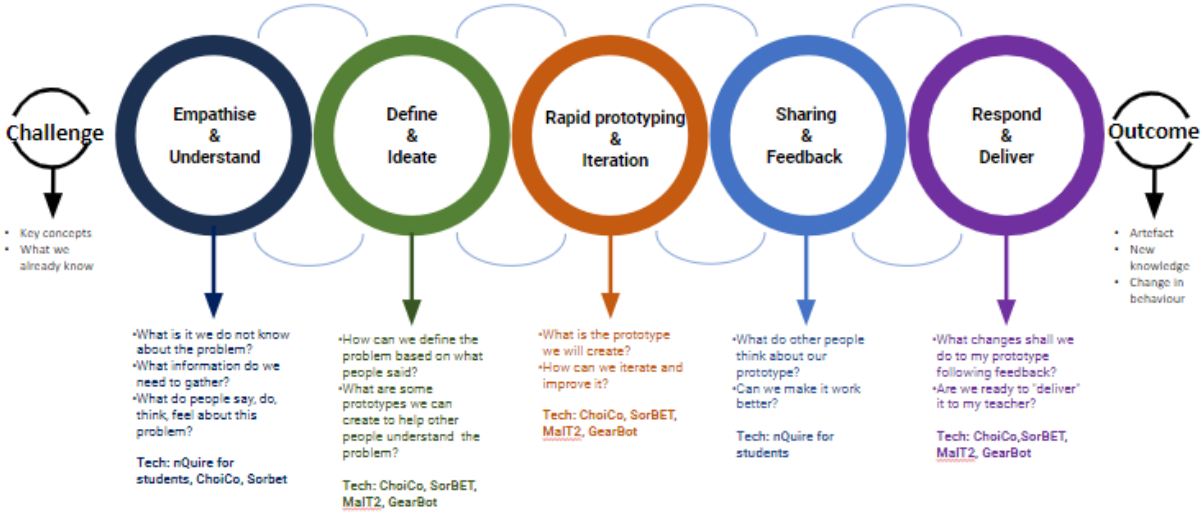
Grouping Criteria	Student preferences
Organization	1 group of 2 students and 1 group of 3 students
Roles in the group	Emergent roles
Tutor(s) role(s)	Facilitator of the investigation and observer of students' actions

TEACHING RESOURCES

Digital resources	MaLT2 digital microworlds with basic 2D & 3D models created by the teacher
Physical resources	MaLT2 commands (printed)

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

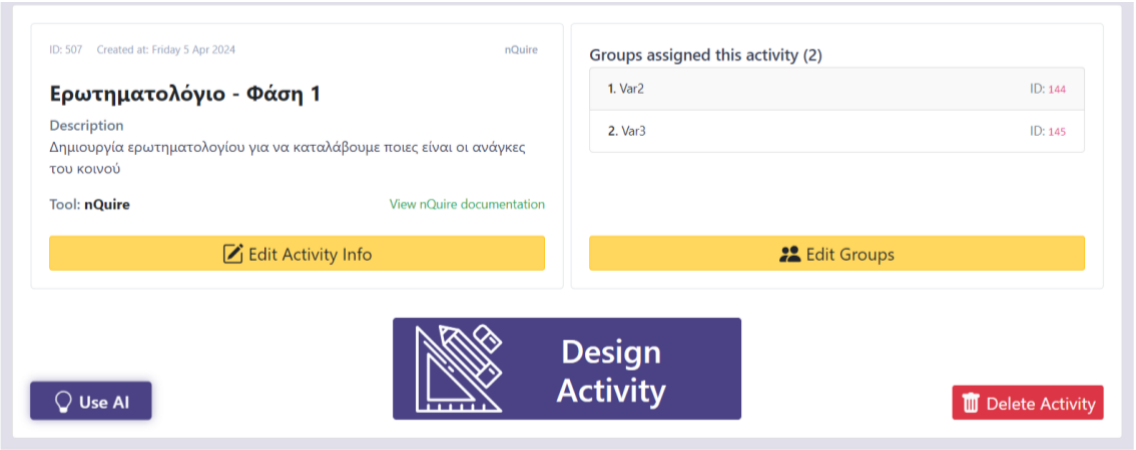
Students explore the implementation of an unusual idea. The basic concepts are the construction of a personal object for others and the use of solid elements. The students know nothing about the construction of objects and have elementary knowledge of stereometry. So, the first thing they need to know is what other people prefer as a personal object.

PHASE 1: EMPATHISE & UNDERSTAND

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In this phase the children will explore and ask about the issue of personal item preferences they are concerned about. They'll be told they can print items such as a lanyard or a key ring, and they'll be waiting for feedback on what they think they'd like. For these reasons, they will create a questionnaire in NQuire. The students first discuss the issue of creating personalized items with the teacher and explore the value or use of these items in everyday life. They then explore some ready-made examples of designs in MaLT2 to get some ideas about the possibilities they have in designing 3D objects and to help them decide on questions they want to ask their audience (potential users) and create an online questionnaire using NQuire (designed activity in the ExtenDT2 platform, see screenshot below). Following, they share the questionnaire with their classmates by sending the link of the mission via e-class and collect the answers.



EXPECTED USE OF EXTENDT2 TECHNOLOGY:

+ **MaLT2** ☐ ChoiCo ☐ SorBET ☐ VRobotics + **NQuire** ☐ No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire.

STUDENTS' EXPECTED INTERACTIONS:

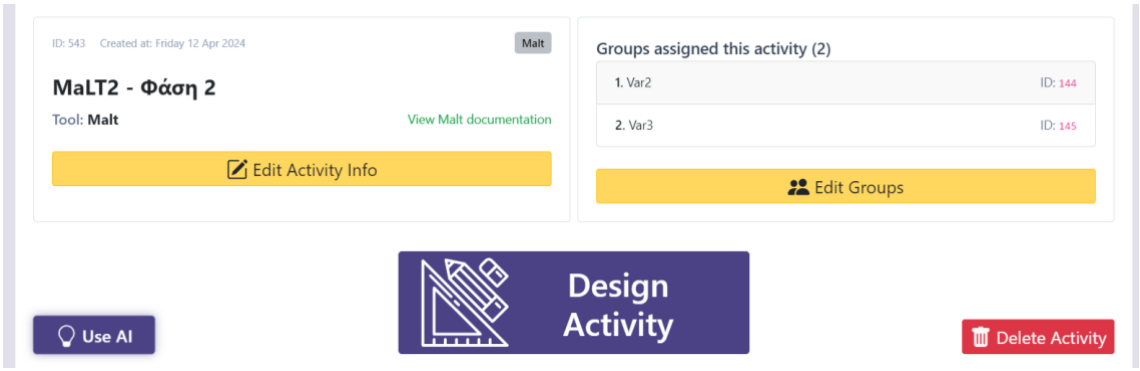
Between the members of the group	*Discussion and argumentation on what questions need to be included in the questionnaire*
Between the groups	*Interactions between the groups around these questionnaires*

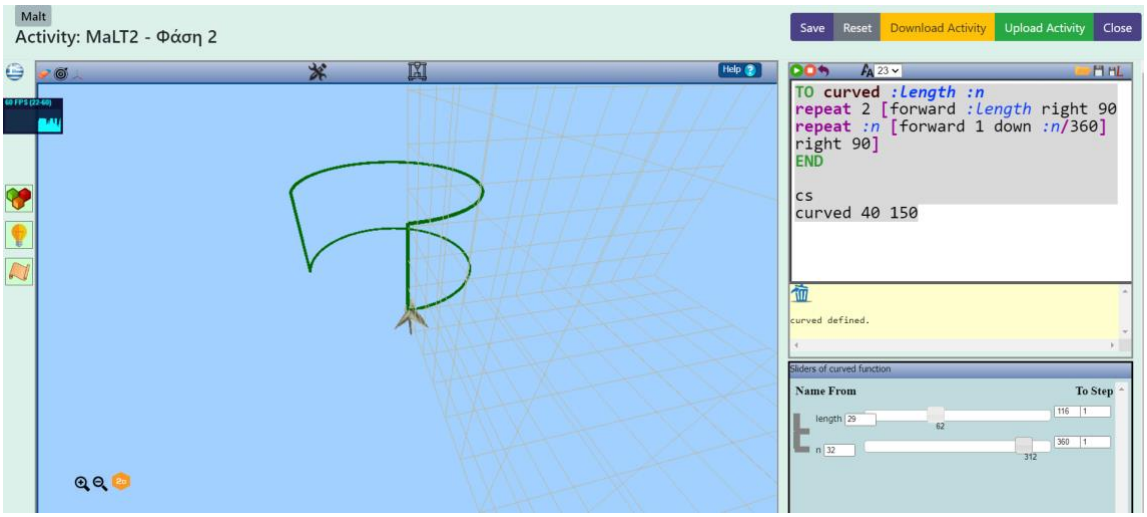
PHASE 2: DEFINE & IDEATE

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

To define the issue of personal item preferences, students analyze the answers to the NQuire questionnaires with their group and discuss interesting findings that might be useful for developing a first idea and an initial design for their 3D object in MaLT2. They suggest ideas on how to proceed with the design, e.g. what shapes to use or create, taking into account the data collected from their questionnaires. They experiment with the existing procedures in MaLT2 and maybe select the ones they need to compose their model (e.g. a code that creates a cylinder from a curved rectangle - see screenshots below).





EXPECTED USE OF EXTENDT2 TECHNOLOGY:

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: An initial design for their 3D object on paper or in MaLT2.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	*Discussion and argumentation on their decisions*
Between the groups	*Debate on their statements*

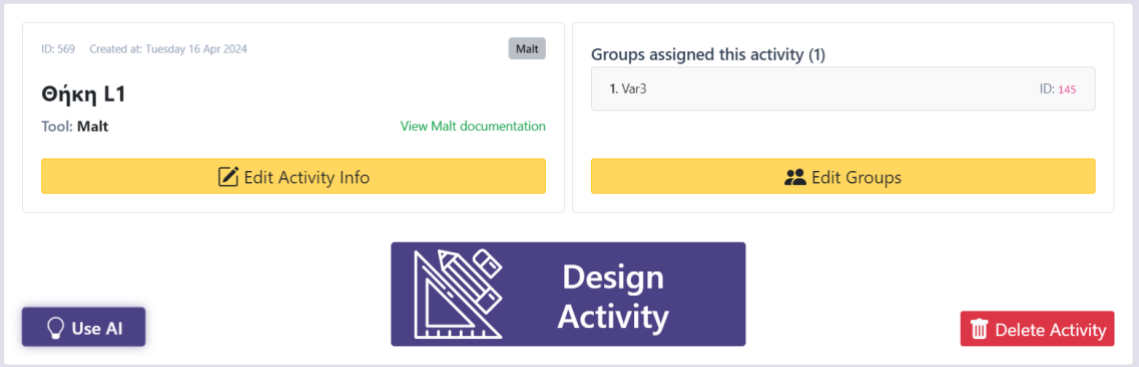
PHASE 3: RAPID PROTOTYPING & ITERATION

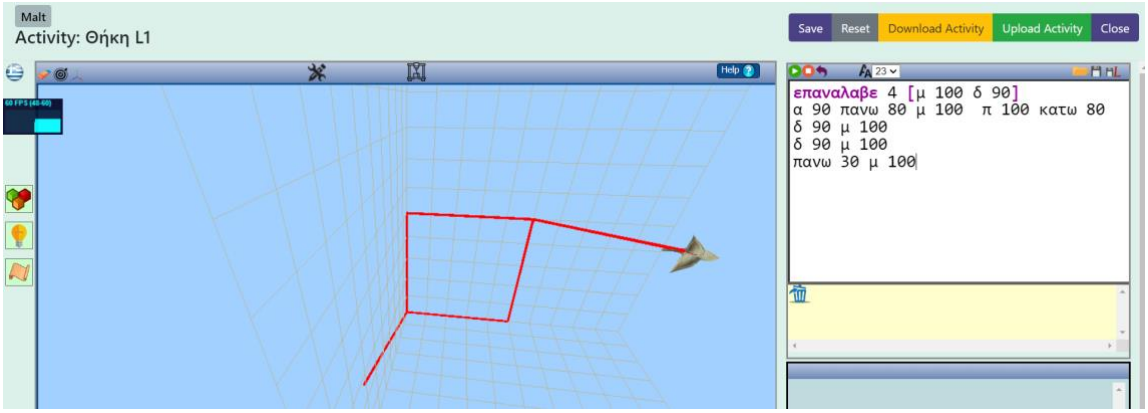
DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

Depending on the choices made by the groups regarding the shapes that they will use to construct their model, the teacher will give them some "half-baked" artifacts (e.g. "half-baked" trapezium parallelogram - see screenshots below) to help the students save some time and focus on the

mathematical concepts or properties that they will have to modify in order to construct the desired model. So, in this phase, the groups of students design the personalized object they have chosen by constructing different prototypes in MaLT2, testing them mainly through the dynamic manipulation of the model and the 3D scene and camera of the tool and improving them until a final version of the artifact is ready. The different prototypes will be online in the ExtenDT2 platform so that they can follow the previous versions, reflect on them and discuss the extent to which these prototypes are what they had agreed on during the 'ideate' phase. They also decide which prototype to print.





EXPECTED USE OF EXTENDT2 TECHNOLOGY:

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: MaLT2 3D models

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	*Making and editing logo code, argumentation on the mathematical concepts/properties they use to construct their models*
Between the groups	-

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

The students give a brief oral presentation to the teacher and the other group of the model they have designed and built and show the printed prototype they have agreed on in the previous phase. They also give the other group some time to tinker with their model by testing the code behind it and dynamically manipulating the artifact. They can then ask any questions about the model, its use or how it was constructed in the digital tool and give written feedback to the group that designed the object. The groups then have some time to reflect and decide on possible changes to their models based on the feedback they have received (e.g. which parts of the feedback given by the other group are technically feasible and which are not), and to make these changes in order to have their final product printed.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Final MaLT2 3D models

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion on the feedback Argumentation on the modifications Decision on the final changes Experimentation with the logo code
Between the groups	Exchanging prototypes and debating on these They discuss every group's ideas and achievements

PHASE 5: RESPOND & DELIVER

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

The students prepare a poster to present and demonstrate the final product to potential users through a school presentation that takes place at the end of the school year between all classes. During the presentation they will also present the changes that they made following the feedback and discuss possible refinements as an afterlife plan for the project.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire + No technology

STUDENT CONSTRUCTIONS: A poster

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion on the preparation of the poster and the presentation Reflection on the whole process, the different prototypes and the final item
Between the groups	Discussion on each group's construction

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Observers' notes and MaLT2 codes.

APPROACH

Learning Outcome	Assessment Activity
• Use mathematical expressions, properties and relationships of 3D shapes to build the objects they want to. • Combine different mathematical objects to achieve their designs.	• By observing the groups during the construction of the code and also through the different prototypes stored in the ExtenDT2 platform. • By checking the students' final artifacts and the way they have used mathematics. • The teacher can also assess the students' understanding through their responses during the process and provide targeted feedback to address any misconceptions.
• Create 3D-objects as rapid prototypes and debate on elaborating them or not. • Test their constructions (digital models in MaLT2 and 3D printouts).	
• Analyze information and define their goal. • Interpret the answers of the questionnaires in order to define the design criteria for their models.	• By asking questions about the users' ideas or needs behind the design of each object or prototype. • By observing students' contributions to the discussions and providing feedback on their understanding of user-centered design principles.

• Compare their prototypes.	
• Plan their actions in order to review these prototypes. • Revise their plans based on their decisions and the feedback from their peers.	
• Collaborate for a certain goal. • Make other people's ideas come true, through discussion.	
• Present their final artifacts by demonstration.	• Through the poster and the presentation.

Appendix H

MAKE PUZZLES - DESIGN THINKING ACTIVITY PLAN — YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Make puzzles

AUTHOR(S):

NKUA

ISSUE:

Puzzle construction needs to satisfy various criteria, aesthetically, but also elements that make it challenging as a game. Students will explore how they can construct such a puzzle with the technology available to them.

FINAL STUDENT PRODUCTION:

Puzzles, printed on a 3d printer that many people will like and play with.

TECHNOLOGIES TO BE USED:

☒ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☒ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Mathematics	• Use mathematical expressions and relationships, like ratio, linear relationship, trigonometry, similarity, etc., to build the puzzles they want to. • Combine different mathematical objects to achieve their designs.
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• To create set of shapes as rapid prototypes and debate on elaborating them or not. • Apply their designs.

	• Employ tools to realize their plans into constructions. • To test their constructions.
Analysis	• To collect information about their project. • To analyze information and define their goal. • To play with the prototype puzzles • To compare their prototypes.
Reflecting & Feedback	• To plan their actions to review the prototypes. • To assess their products. • To make conclusions and revise their plans.
21st century Skills Related	
Communication	• To think what would be provoking for others. • To collaborate for a certain goal. • To make other people's ideas come true, through discussion. • To defend their position using argumentation.
Presentation	• Present their final artifact by demonstration

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	Grade 8-9, 13-14 years old
Prior knowledge	basic knowledge of programming concepts with Logo, trigonometry, basic algebra (simple functions, algebraic expressions, etc.)
Nationality, gender, cultural background	21-25 pupils from Greece
Language	Greek

Special needs and abilities	-

TIME

ACTIVITY DURATION: 8 hours - 2 sessions

IMPLEMENTATION DURATION: 2 weeks

SCHEDULE: 4 hours/week

SPACE

ACTIVITY TYPE: ☒ **In-person** ☐ At distance ☐ Mixed

PHYSICAL SPACE: computer laboratory

VIRTUAL SPACE: E-class (if needed)

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 13 No of GROUPS : 5-6 No of TUTORS: 1 No of ASSISTANTS: 1-2

STUDENT GROUPING & INTERACTIONS

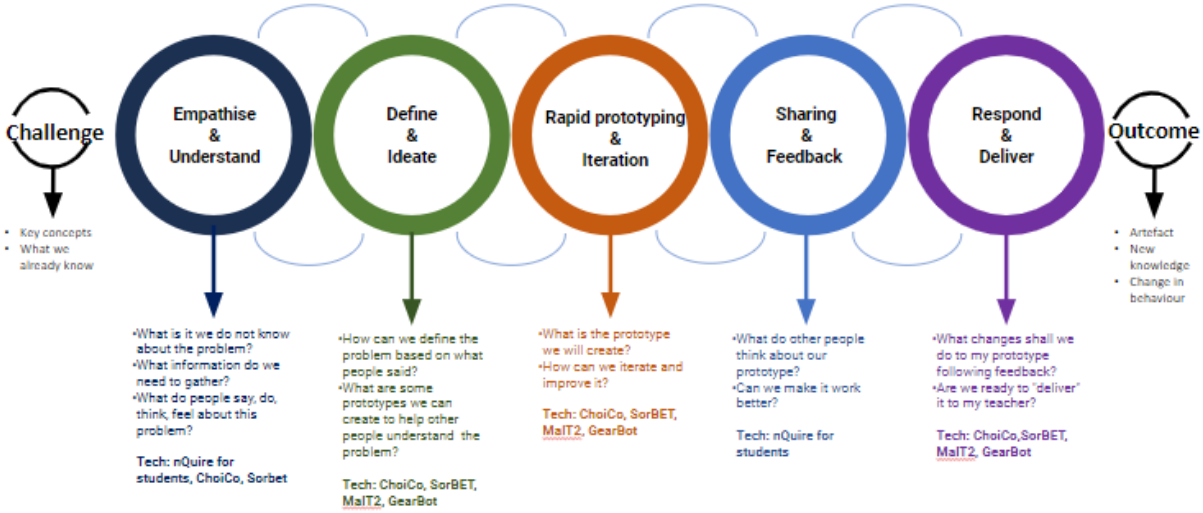
Grouping Criteria	Student preferences as understood by the teacher so that there are better opportunities for collaboration
Organization	Students sit in groups of 3 in the computer lab, with one computer available per group
Roles in the group	One keyboard operator, one takes notes and one has the worksheets we give them. The roles are reversed
Tutor(s) role(s)	Facilitator of the investigation and observer of students' actions.

2.4 TEACHING RESOURCES

Digital resources	eMaLT2 microworld with basic 2D & 3D models created by the teacher, NQuire
Physical resources	-

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathize & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Students need to investigate what forms a descent puzzle, which are the criteria; what dimensions, aesthetical characteristics, what make it provoking. They then need to figure out how to use the available software to make pieces of puzzles.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

Students research the internet about various types of shapes that can be used to form a puzzle, discuss their ideas, create a questionnaire to collect their peers' preferences and they answer other group's questionnaires.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics + **NQuire** ☐ No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on what questions need to be included in the questionnaire
Between the groups	Interactions between the groups around these questionnaires

PHASE 2: DEFINE & IDEATE

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

In the "Define & Ideate" phase, students think of possible models based on the information gathered in phase 1 aiming to define (narrow down / converge) certain features of the puzzle they will create. They determine what a puzzle is (as an object and as a game as well) and what the criteria are to see if it is suitable to make it. They identify the characteristics of the object to meet the criteria they have formulated, based on the answers to the NQuire

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Experiment with the existing procedures in MaLT2 and select the ones they need to compose a puzzle, which corresponds the criteria.

STUDENT CONSTRUCTIONS: Malt2 models

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion, argumentation, preparation of a presentation
Between the groups	Debate on their statements.

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2-3 hours

DESCRIPTION OF THE ACTIVITIES:

In the "Rapid prototyping & Iteration" phase students design in their group a range of prototypes for their puzzle, testing them internally in their group and redesigning them until a final version is ready. They debate on what extend these prototypes are what they had agreed on, during the 'ideate' phase. They decide on which prototype they are going to print.

This phase is interrupted so that in the interval the constructions of the students can be printed. These constructions are presented to all the students, the puzzles will be available for them to play with, and give their feedback though a new questionnaire in NQuire (they will vote for the best puzzle-prototype) till this moment). Then they will continue to try to make them even better.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Students will use Logo by running programs with their new ideas. They will send some of them to be printed and then after seeing the printed items they will redesign. They are expected to be active by adopting a maker culture

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics + NQuire ☐ No technology

STUDENT CONSTRUCTIONS: MaLT2 3D models and printed models

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Making and editing logo code.
Between the groups	Exchanging prototypes, debating on these prototypes.

PHASE 4: SHARING & FEEDBACK

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In the "Sharing & Feedback" phase students focus on (converge) their final model and its delivery to the target audience and the public. They have already got the printed prototypes to their families and friends in order to get feedback. They discuss this feedback. They make decisions on possible modifications.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: *New version of MaLT2 models.*

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	They work together. They assign roles. They argue about their ideas or how to change them based on the printed model and the on-screen model.
Between the groups	They discuss the feedback in the whole classroom

PHASE 5:RESPOND & DELIVER

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES

In the "Respond & Deliver" phase, students present and demonstrate the final product to potential users, discussing possible refinements as an afterlife plan for the project according to the feedback given in the previous phase. Students apply modifications on the logo code, in groups. They discuss all group's ideas and achievements. They decide which will be the final object to be printed.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

+ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Final versions of 3D models in MaLT2

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Experimentation with the logo code.
Between the groups	Discussion on each group's construction.

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

observers' notes.

APPROACH

Learning Outcome	Assessment Activity
• Use mathematical expressions and relationships, like ratio, linear relationship, trigonometry, similarity, etc., to build the puzzles they want to. • Combine different mathematical objects to achieve their designs.	Review of the students' programs in their final artifacts and the way they used mathematics
• To create set of shapes as rapid prototypes and debate on elaborating them or not. • Apply their designs. • Employ tools to realize their plans into constructions. • To test their constructions.	Review of the students' programs in their final artifacts and the way they used mathematics

• To collect information about their project. • To analyze information and define their goal. • To play with the prototype puzzles • To compare their prototypes.	Review of the students' programs in their final artifacts and the way they used mathematics
• To plan their actions to review the prototypes. • To assess their products. • To make conclusions and revise their plans.	Review of the students' programs in their final artifacts and the way they used mathematics
• To think what would be provoking for others. • To collaborate for a certain goal. • To make other people's ideas come true, through discussion. • To defend their position using argumentation.	Review of the students' programs in their final artifacts and the way they used mathematics
• Present their final artifact by demonstration	Review of the students' programs in their final artifacts and the way they used mathematics
• Use mathematical expressions and relationships, like ratio, linear relationship, trigonometry, similarity, etc., to build the puzzles they want to. • Combine different mathematical objects to achieve their designs.	Review of the students' programs in their final artifacts and the way they used mathematics
• To create set of shapes as rapid prototypes and debate on elaborating them or not. • Apply their designs. • Employ tools to realize their plans into constructions. • To test their constructions.	Review of the students' programs in their final artifacts and the way they used mathematics
• To collect information about their project. • To analyze information and define their goal. • To play with the prototype puzzles • To compare their prototypes.	Observer's notes

• To plan their actions to review the prototypes. • To assess their products. • To make conclusions and revise their plans.	Review of the students' programs in their final artifacts and the way they used mathematics
• To think what would be provoking for others. • To collaborate for a certain goal. • To make other people's ideas come true, through discussion. • To defend their position using argumentation.	Observer's notes
• Present their final artifact by demonstration	Review of the students' programs in their final artifacts and the way they used mathematics
• Use mathematical expressions and relationships, like ratio, linear relationship, trigonometry, similarity, etc., to build the puzzles they want to. • Combine different mathematical objects to achieve their designs.	Review of the students' programs in their final artifacts and the way they used mathematics
• To create set of shapes as rapid prototypes and debate on elaborating them or not. • Apply their designs. • Employ tools to realize their plans into constructions. • To test their constructions.	Review of the students' programs in their final artifacts and the way they used mathematics

Appendix I

THE WICKED PROBLEM ISSUE-SUSTAINABLE CITY - DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

The wicked problem issue

AUTHOR(S):

UGENT

ISSUE:

The world is confronted with quite a lot of wicked problems. The UN has defined 17 SDG's society should work on. One is the SDG's is developing sustainable cities and communities. In this project the students will design a sustainable living environment for a specific use and analyze the positive and negative consequences of each choice one makes.

FINAL STUDENT PRODUCTION:

A ChoiCo simulation with a variety of Solutions for making the living environment (city, community) more sustainable for a pre-defined user.

TECHNOLOGIES TO BE USED:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
society and STEM	• Recognize the relationship between society and STEM-disciplines
Design Thinking & innovation with Emerging Technologies Related	
Brainstorm and critical thinking	• State different Solutions to a well-defined wicked problem depending on the perspective and specific needs of het user
Prototyping	• Design, develop and create a ChoiCo prototype

Analysis	• Analyze the relationship between living environment and STEM disciplines
21st century Skills Related	
Communication	• Explain ideas to others (peers) • Discuss different solutions and the consequences to the issues at hand
Creativity	• Develop an attractive ChoiCo game with sound effects

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	17-18 year old
Prior knowledge	Basic knowledge of programming concepts with scratch; general knowledge about SDG's
Nationality, gender, cultural background	Very diverse student population, more than 10 different nationalities, different cultural backgrounds. Mix of boys, girls and undefined.
Language	Dutch
Special needs and abilities	some students have ADHD and other learning difficulties

TIME

ACTIVITY DURATION: 8 hours divided into 5+3

IMPLEMENTATION DURATION: 2 days in the same week

SCHEDULE: 5h+ 3h/1 week

SPACE

ACTIVITY TYPE: ☒ **In-person** ☐ At distance ☐ Mixed

PHYSICAL SPACE: classroom, students are divided over 3 rooms

VIRTUAL SPACE: none

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 60 No of GROUPS : 12 No of TUTORS: 1 No of ASSISTANTS: 2

STUDENT GROUPING & INTERACTIONS

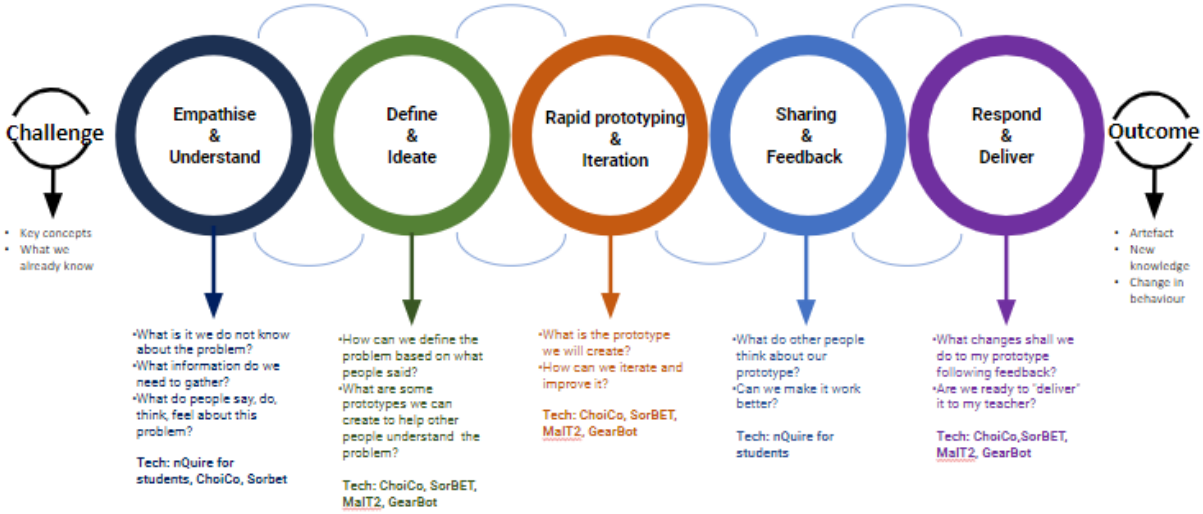
Grouping Criteria	Every group has a member that is familiar with programming, students from different study programs (sciences, social Sciences, languages)
Organization	4 students per group using 2 computers per group
Roles in the group	There was a game designer, a tester of the game, a reporter and a graphic responsible.
Tutor(s) role(s)	coach

2.4 TEACHING RESOURCES

Digital resources	a computer, extendt(2), website, internet
Physical resources	translated ChoiCo manual

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathize & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Sustainable cities and communities are mostly not organized in a sustainable way (traffic, sustainability of houses and infrastructure, possibility to meet other people, organize events,...) Students have to suggest Solutions to make cities and communities more sustainable, with specific attention for a given group of citizens. Students will have to look up more closely what SDG11 is about, look at the city of Ghent where the school is situated, empathize with their specific user group.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

The goal and organization of the activity is communicated to the students. Students are divided into groups. In this phase, every student group gets a link to a website with the SDG's. They first look up what the SDG 11 is about and discuss the SDG 11 within their group. Then they analyze the present situation in the city of Ghent with respect to SD11: what public transport is available, are there parks or places where people can meet, how is the city organized,.... Each group gets a specific group of citizens (older and/or less mobile people, youngsters, owner of a bar or restaurant). The groups have to find out what the needs of their specific citizens are with regard to living in a sustainable city and/or community. They discuss their findings because these are useful for developing a concept for the game they will develop.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire + No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Students discuss the initial ideas on games they could create
Between the groups	Different groups do not interact during this phase

PHASE 2: DEFINE & IDEATE

DURATION: 1 hours

DESCRIPTION OF THE ACTIVITIES:

The students analyze the possible impact (positive or negative) of their possible Solutions on at least three different items (e.g. financial cost, time, fun,…) and put their findings (strongly positive, positive, neutral, negative, strongly negative) in a table. After that they assign values to the impacts. This way they create a prototype for their game.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Students experiment and ideate with ChoiCo

STUDENT CONSTRUCTIONS: paper and digital prototype of the game

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion
Between the groups	None

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 hour

DESCRIPTION OF THE ACTIVITIES:

Students ask feedback on their paper prototype of their ChoiCo simulation. After feedback from the teachers/ researchers, they create a digital prototype and program their simulation. During the development they can test if their simulation works well.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Students will ChoiCo to create multiple prototypes of their game based on their peers' feedback.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: paper and digital prototype of the game

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion
Between the groups	None

PHASE 4: SHARING & FEEDBACK

DURATION: 2 hour

DESCRIPTION OF THE ACTIVITIES:

Students write their feedback on a paper, with positive as well as negative notes. After that, they share their feedback with the groups. They also receive feedback on their own prototype, which they can use to make their game better.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: New version of ChoiCo games

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire + No technology

STUDENT CONSTRUCTIONS: document with feedback on games of other groups

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion about feedback on the games
Between the groups	giving feedback to other groups

PHASE 5:RESPOND & DELIVER

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES

Students change their prototype based on the feedback they received from their peers. After that, they deliver it to the teacher.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: a final game

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion
Between the groups	different groups do not interact during this phase

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Students are evaluated with the use of rubrics designed by the teacher

APPROACH

Describe the formative and summative assessment activities. How these assess the achievement of the learning objectives as described in section 2.1.

Learning Outcome	Assessment Activity
• Recognize the relationship between society and STEM-disciplines	Rubric
• State different Solutions to a well-defined wicked problem depending on the perspective and specific needs of the user	Rubric
• Design, develop and create a ChoiCo prototype	Rubric
• Analyze the relationship between living environment and STEM disciplines	Rubric
• Explain ideas to others (peers) • Discuss different solutions and the consequences to the issues at hand	Rubric
• Develop an attractive ChoiCo game with sound effects	Rubric
• Recognize the relationship between society and STEM-disciplines	Rubric
• State different Solutions to a well-defined wicked problem depending on the perspective and specific needs of het user	Rubric
• Design, develop and create a ChoiCo prototype	Rubric
• Analyze the relationship between living environment and STEM disciplines	Rubric

• Explain ideas to others (peers) • Discuss different solutions and the consequences to the issues at hand	Rubric
• Develop an attractive ChoiCo game with sound effects	Rubric

Appendix J

THE WORLD OF MUSIC & SOUND ACTIVITY PLAN- DESIGN THINKING ACTIVITY PLAN YEAR 2

Title of the Design Thinking (DT) Project

The world of music and sound

AUTHOR(S)

Name(s) of teacher(s), designer(s), researcher(s) who created the Activity Plan

Andreas Boussery

ISSUE

Briefly describe the problem or the topic that this DT project seeks to solve in 1-2 sentences.

The pupils learned a lot about music (waves, frequencies,..) and now they can use the information to make a combatgame

FINAL STUDENT PRODUCTION

What is the expected final artifact that will be produced by the students using emerging technologies throughout the DT project?

a game full of competition

TECHNOLOGIES TO BE USED

Select the ExtenDT2 technologies that will be used by students during the DT Project

- [ ] MaLT2
- [x] ChoiCo
- [ ] SorBET
- [ ] VRobotics
- [ ] nQuire for Students
- [ ] Other

mathematics	5/10 (algorithm)
Physics	8/10 (waves, frequency)
technology	3/10
informatics	10/10 (scratch)

Design Thinking & Innovation with Emerging Technologies Related	
prototyping	The pupils started with 2 scenario's and they had to come up with another story (relation between cause and effect)
critical thinking	
problem solving	
analysis	
creativity	

21st century Skills Related	
communication	to ask the more experienced pupils (experienced with Scratch)

PARTICIPANTS & CONTEXT

STUDENTS

Age	12-14 year
Prior knowledge	basic knowledge of Scratcgh
Nationality, gender, cultural background	11 pupils (4 boys, 7 girls)
Language	Dutch
Special needs and abilities	2 pupils are really expert in programming

TIME

ACTIVITY DURATION 5 x 50 min

IMPLEMENTATION DURATION 2 weeks

SCHEDULE one week 3 hour, second week 2 hours

SPACE

Specify where the activity will take place

ACTIVITY TYPE ☑ **In-person** ☐ At distance ☐ Mixed

PHYSICAL SPACE classroom

VIRTUAL SPACE Google classroom, Classercraft

SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS 11 **No of GROUPS** 5 **No of TUTORS** 1 **No of ASSISTANTS** /

TEACHING RESOURCES

Digital resources	two friends
Physical resources	guide

PHASE 0: Challenge

Give a short description of the challenge the project addresses.

- What is the problem or issue your students would like to explore?
- What are the key factors that are related to the issue at hand?
- What do the students already know about it?
- What information do they need to gather?

Every pupil starts playing the game the teacher constructed. Second thing is to brainstorm what other possibilities or pathways there can be in the game.

PHASE 1: Empathise & Understand

In the "Empathise & Understand" phase students explore (diverge) and understand the problem of their Design Thinking project for which they will develop a final artifact. This involves empathising with their potential audience, creating online surveys in nQuire asking questions to discover their needs and exploring various aspects of the problem and developing an understanding of the issue at hand. When you design the activity think about how you are going to support your students:

- Who are the people involved that can help you explore the problem or issue you have identified?
- What do they say, do, think, feel about this problem?

Duration	1 hour

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ **ChoiCo** ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Students' expected interactions

Between the members of the group	
Between the groups	

PHASE 2: Define & Ideate

In the "Define & Ideate" phase, students think of possible solutions based on the information gathered in phase 1 aiming to define (narrow down / converge) certain features of the artifact they will create. This involves, for example, deciding on an initial first structure, setting criteria and deciding on specific features e.g. define the main gaming idea and the basic game elements in ChoiCo and SorBET, or define the material and type of their 3D model in MaLT2. When you design the activity think about how you are going to support your students:

1. **to define** the problem to be solved:
   - How can I define the problem based on what people said?
2. **to ideate**:
   - What are some possible solutions to solve the problem?

Duration	1 hour

> 💡 *Students need some time to see and analyze the data from the questionnaires of phase 1. You can do this in the classroom as a whole or ask them to do it at home.*

Expected use of Exten(DT)² technology

Student constructions

Students' expected interactions

Between the members of the group	compare their ideas. Togheter they balanced the solutions of the wicked problem
Between the groups	Between the different classgroups there was ediscussion of the first stages.

PHASE 3: Rapid prototyping & Iteration

In the "Rapid prototyping & iteration" phase, students are encouraged to give different answers (diverge again) to the initial problem by designing in their group a range of prototypes for their artifact, testing them internally in their group and redesigning them until a final version is ready. This involves, for example, creating low-fidelity game prototypes, testing them in the group and keep refining them. The ExetnDT2 tools allow for rapid prototyping and testing as they support quick transition between play & design modes (ChoiCo & SorBET), dynamic manipulation of the model (MaLT2) and instant testing of the solution (virtual robotics). They also support quick save that allow students to keep versions of their work.

Discuss with your students:

- What are the prototypes they will create?
- How can they iterate and improve their prototypes?

Duration 1 hour

> 💡 *Take into account the time your students need to learn how to use the tool. Would a half-baked artifact, a presentation or a tutorial that guides them to make changes be helpful for the students to get to know the tool's functionalities? Find free online supporting material for the tools here.*

> 💡 *How can you prompt students to test and iterate their prototype?*

> 💡 *Provide your students with materials or guidelines to track their work during this phase. For example, you can provide them with a checklist where they can note how many prototypes have been created so far.*

> 💡 *Remind your students to save versions of their work regularly.*

> 💡 *Ask them about changes they made and the reasons they made them.*

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Student constructions

Students' expected interactions

Between the members of the group	In every group of 2 persons, they had to work individually on a game and compare their ideas. Togheter they balanced the solutions of the wicked
Between the groups	Between the different classgroups there was ediscussion of the first stages.

PHASE 4: Sharing & Feedback

In the "Sharing & Feedback" phase, students focus on (converge) their final solution and its delivery to the target audience and the public. This involves sharing their final artifact and testing it with people outside their group (e.g. other groups, classmates, teachers, etc). In this stage, they can use ExtenDT2 technologies, e.g. nQuire for students to create online surveys by giving a link of their final product within this tool and share it with the target audience (e.g. other students, teachers, parents) and ask them to evaluate it.

Encourage your students to think:

Desctiption of the activities

> *Think whether your students have been engaged in giving feedback before. If not, consider providing them hints and keywords that could support them in providing constructive feedback that can be useful for others. You can give each group a feedback worksheet to fill in while testing others' artifacts.*

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ **ChoiCo** ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Student constructions

Students' expected interactions

Between the members of the group	
Between the groups	

PHASE 5: Respond & Deliver

In the "Respond & Deliver" phase, students present and demonstrate the final product to potential usersdiscussing possible refinements as an afterlife plan for the project according to the feedback given in the previous phase. In this phase, students can deliver their final solution through a class/school presentation, a pitch video/poster, or through a public mission in the nQuire platform.

Encourage your students to think about and discuss:

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ **ChoiCo** ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Student constructions

Students' expected interactions

Between the members of the group	
Between the groups	

TOOLS

Describe the assessment tools that will be used

The groups showed or played the game for the class and explained what their intentions were.

The teacher made a rubric to give the feedback. It was an individual evaluation.

APPROACH

Describe the formative and summative assessment activities. How these assess the achievement of the learning objectives as described in section 2.1.

Learning Objective	Assessment Activity

Appendix K

ECOLOGY IN THE CITY – EXTEN(D.T.)2 - DESIGN THINKING ACTIVITY PLAN YEAR 2

Activity Plan Template

Created at 16/7/2024

1. BASIC INFORMATION

PROJECT TITLE
Title of the Design Thinking (DT) Project

Ecology in the city

AUTHOR(S)
Name(s) of teacher(s), designer(s), researcher(s) who created the Activity Plan

Iarre Lafort

ISSUE
Briefly describe the problem or the topic that this DT project seeks to solve in 1-2 sentences.

In Dendermonde, the city they live, there is a problem with mobility, but more streets means lost of green zones. How can we make the best solution

FINAL STUDENT PRODUCTION
What is the expected final artifact that will be produced by the students using emerging technologies throughout the DT project?

a choico game

TECHNOLOGIES TO BE USED
Select the ExtenDT2 technologies that will be used by students during the DT Project

☐ MaLT2 ☑ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire for Students ☐ Other

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

LEARNING OBJECTIVES

Learning Objective	
Biotechnology	kind of flower best for the streets

Design Thinking & Innovation with Emerging Technologies Related	
prototyping	
analysis	
reflecting and feedback	

21st century Skills Related	
communication	
discussion	Listen to different solutions
presentation	

STUDENTS

Age	17-18
Prior knowledge	a lot of knowledge of plants
Nationality, gender, cultural background	11 Belgian pupils
Language	Dutch
Special needs and abilities	/

TIME

ACTIVITY DURATION: 8h

IMPLEMENTATION DURATION: 4 weeks

SCHEDULE: 2 hours /week

SPACE

Specify where the activity will take place

ACTIVITY TYPE: ☑ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: calssroom

VIRTUAL SPACE:

SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 11 | No of GROUPS: 3 | No of TUTORS: 1 | No of ASSISTANTS: /

STUDENT GROUPING & INTERACTIONS

Grouping Criteria	student preferences
Organisation	max 4 students, 2 laptops
Roles in the group	no roles
Tutor(s) role(s)	coach

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology:

1. Empathise & Understand
2. Define & Ideate
3. Rapid prototyping & Iteration
4. Sharing & Feedback
5. Respond & Deliver

The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.

PHASE 0: Challenge

Give a short description of the challenge the project addresses.

- What is the problem or issue your students would like to explore?
- What are the key factors that are related to the issue at hand?
- What do the students already know about it?
- What information do they need to gather?

PHASE 1: Empathise & Understand

In the "Empathise & Understand" phase students explore (diverge) and understand the problem of their Design Thinking project for which they will develop a final artifact. This involves empathising with their potential audience, creating online surveys in nQuire asking questions to discover their needs and exploring various aspects of the

> 💡 *Take into account that activities, such as creating a questionnaire using 'nQuire for students' require your students to become familiar with the tool.*

> 💡 *Take some time to present the functionalities of nQuire for students to your students (e.g. show them an existing 'mission'.) Ask them to think of the questions they will ask first and then create their 'mission'. To save time, each group can distribute their missions to their classmates or school teachers during a recess (e.g. using tablets).*

Description of the activities

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ **ChoiCo** ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Students' expected interactions

Between the members of the group	discussion
Between the groups	no interaction

PHASE 2: Define & Ideate

In the "Define & Ideate" phase, students think of possible solutions based on the information gathered in phase 1 aiming to define (narrow down / converge) certain features of the artifact they will create. This involves, for example, deciding on an initial first structure, setting criteria and deciding on specific features e.g. define the main gaming idea and the basic game elements in ChoiCo and SorBET, or define the material and type of their 3D model in MaLT2. When you design the activity think about how you are going to support your students:

1. **to define** the problem to be solved:
   - How can I define the problem based on what people said?
2. **to ideate**:
   - What are some possible solutions to solve the problem?

> *develop a prototype for.*

Desctiption of the activities

discussion of the information

> 💡 *Do your students use the conclusions from the data they gathered during the previous phase in developing their project's criteria? Discuss with them how the criteria they set for their project relate to the data gathered during the previous phase.*

Expected use of Exten(DT)² technology

Student constructions

conclusions on paper

Students' expected interactions

Between the members of the group	argumentation and discussion
Between the groups	non

PHASE 3: Rapid prototyping & Iteration

In the "Rapid prototyping & iteration" phase, students are encouraged to give different answers (diverge again) to the initial problem by designing in their group a range of prototypes for their artifact, testing them internally in their group and redesigning them until a final version is ready. This involves, for example, creating low-fidelity game prototypes, testing them in the group and keep refining them. The ExetnDT2 tools allow for rapid prototyping and testing as they support quick transition between play & design modes (ChoiCo & SorBET), dynamic manipulation of the model (MaLT2) and instant testing of the solution (virtual robotics). They also support quick save that allow students to keep versions of their work.

Discuss with your students:

> *Remind students to test their digital artifacts during this phase.*

> *Encourage students to reflect on what they learned from the empathising activities and their defining activities. Make them think what the next steps are, what is missing, what could be improved etc.*

Desctiption of the activities

discussion of the information

> *How can you prompt students to test and iterate their prototype?*

> *Provide your students with materials or guidelines to track their work during this phase. For example, you can provide them with a checklist where they can note how many prototypes have been created so far.*

> *Remind your students to save versions of their work regularly.*

> *Ask them about changes they made and the reasons they made them.*

Expected use of Exten(DT)² technology

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ **ChoiCo** ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Student constructions

conclusions on paper

Students' expected interactions

Between the members of the group	argumentation and discussion
Between the groups	non

- How will they know what other people think about their prototype?
- Can they make it work better?

Duration

> 💡 *Structure the activity in order for the students to have time to experiment with others' prototypes as well as give feedback.*

Desctiption of the activities

> 💡 *Think whether your students have been engaged in giving feedback before. If not, consider providing them hints and keywords that could support them in providing constructive feedback that can be useful for others. You can give each group a feedback worksheet to fill in while testing others' artifacts.*

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Student constructions

a game with a lot of information (prices, growth of plants,..)

Students' expected interactions

Between the members of the group	
Between the groups	

PHASE 5: Respond & Deliver

In the "Respond & Deliver" phase, students present and demonstrate the final product to potential usersdiscussing possible refinements as an afterlife plan for the project according to the feedback given in the previous phase. In this phase, students can deliver their final solution through a class/school presentation, a pitch video/poster, or through a public mission in the nQuire platform.

Duration	1

Desctiption of the activities

iterative process and rebuilding the game

> 💡 *Do students take into account the feedback given to refine their artifact?*

> 💡 *Ask them how they would refine their prototype according to the feedback they got during the previous phase. If they don't have time for making improvements, ask them to note them down (e.g. write down 4-5 changes you would make based on the feedback) or fill in a spreadsheet.*

Expected use of Exten(DT)² technology

☐ MaLT2 ☑ ChoiCo ☐ SorBET ☐ VRobotics ☐ nQuire ☐ No technology

Student constructions

Students' expected interactions

Between the members of the group	
Between the groups	discussion and asking more information of how to play

4. STUDENT ASSESSMENT AND FEEDBACK

What methods and tools will you use to facilitate the assessment of the learning outcomes stated at section 3.1. (e.g., post-activity tests, reflective videos, student worksheets, etc.).

TOOLS

Describe the assessment tools that will be used

discussion, last week of the schoolyear, the students were tired

APPROACH

Describe the formative and summative assessment activities. How these assess the achievement of the learning objectives as described in section 2.1.

Learning Objective	Assessment Activity

Appendix L

ECOLOGY IN THE CITY (B) -NQUIRE DESIGN THINKING ACTIVITY PLAN YEAR2

User contribution for:

Exten(DT)2: Activity plans for teachers

What activities can you do using design thinking and technology?

View mission brief

Contributed by Ilse Mariën
a day ago

Design thinking challenge

- What is the challenge or problem you want your students to engage with?
- What key concepts relate to this problem?
- What do students already know about it?
- What new information do they need to gather?

1. **What is the topic of your design thinking project?**

Ilse Mariën said:

Ecologie in de stad.

2. **Which of the below technologies will you use?**

You can find out more about these technologies here: https://extendt2.eu/technologies/

Ilse Mariën picked:

ChoiCo

Step 1: Empathise & Understand

- What do other people say, do, think, feel about this problem?
- What information do students need to gather?
- **Allow some extra time for your students to become familiar with the technology you are using at each step of Design Thinking.**

Ilse Mariën picked:

Choice

3. **How will you use the above technology?**

What will the students be asked to do with the technology?

What will it be their final artefact?

Ilse Mariën said:

Geen technologie in deze fase, gewoon gesprekken op straat.

4. **What other resources will you use to implement this activity?**

e.g., books, a powerpoint presentation, print-outs, role-playing, poster, guest speaker

Ilse Mariën said:

Interviews op straat

5. **How will students be organised for this activity?**

Ilse Mariën picked:

Students will work in groups

Step 2: Define & Ideate

- How can students define the problem based on what people said?
- What are some prototypes students can create to help other people understand or solve the problem?
- **Allow time for students to analyze the data they collected in Step 1. They can do this in the classroom or as homework.**

1. **How many hours will this phase last for?**

Ilse Mariën said:

Choice

3. **How will you use the above technology?**

What will the students be asked to do with the technology?

What will it be their final artefact?

Ilse Mariën said:

Ook hier geen gebruik van een technologie. Hun artefact is een blad waarop alle ideeën staan en uiteindelijk een aantal uitgekozen ideeën omdirkeld zijn.

4. **What other resources will you use to implement the activity?**

e.g., books, a powerpoint presentation, print-outs, role-playing, poster, guest speaker

Ilse Mariën said:

prints

5. **How will students be organised for this activity?**

Ilse Mariën picked:

Students will work in groups

Step 3: Rapid prototyping & Iteration

- What prototypes will students create?
- How can students iterate and improve their prototypes?

1. **How many hours will this phase last for?**

Ilse Mariën said:

3

2. **Which of the below technologies will you use?**

What will it be their final artefact?

Ilse Mariën said:

Ze gebruiken hier Choico en die staat er niet tussen

4. **What other resources will you use to implement the activity?**

e.g., books, a powerpoint presentation, print-outs, role-playing, poster, guest speaker

Ilse Mariën said:

uitwerken op een blad

5. **How will students be organised for this activity?**

Ilse Mariën didn't give an answer

Step 4: Sharing & Feedback

- What do other people think about the prototypes students created?
- Can students collect feedback and make these work better?
- **Allow some time for students to try the prototypes created by other students and give their feedback.**

1. **How many hours will this phase last for?**

Ilse Mariën said:

1

2. **Which of the below technologies will you use?**

Ilse Mariën picked:

Choico

3. **How will you use the above technology?**

What will the students be asked to do with the technology?

e.g., books, a powerpoint presentation, print-outs, role-playing, poster, guest speaker

Ilse Mariën said:

geen

5. **How will students be organised for this activity?**

Ilse Mariën didn't give an answer

Step 5: Respond & Deliver

- Which of the feedback comments are feasible and which are not?
- What changes can students make to their prototypes following feedback?
- Are students ready to "deliver" their prototypes to their teacher?

1. **How many hours will this phase last for?**

Ilse Mariën didn't give an answer

2. **Which of the below technologies will you use?**

Ilse Mariën picked:

Choico

3. **How will you use the above technology?**

What will the students be asked to do with the technology?

What will it be their final artefact?

Ilse Mariën said:

Hun Choicospel

4. **What other resources will you use to implement the activity?**

e.g., books, a powerpoint presentation, print-outs, role-playing, poster, guest speaker

Ilse Mariën said:

Learning outcomes

1. **What are intended learning outcomes related to the SUBJECT AREA/S of the project?**

e.g., to learn the mathematical properties of 3D shapes used for designing a digital jewel model

Ilse Mariën said:

verschillende soorten ecologische niches leren behouden

---

2. **What are intended learning outcomes related to using TECHNOLOGIES in your DESIGN THINKING project?**

e.g., programming a game,interpret data, develop empathy, create digital prototypes, develop research skills, develop communication skills

Ilse Mariën said:

analyse interviews man op de straat

---

3. **What are intended learning outcomes related to 21st CENTURY SKILLS?**

e.g., problem-solving, data literacy, collaborative skills, creativity, critical thinking

Ilse Mariën said:

ontwikkelen communicatieve vaardigheden, computationele vaardigheden, discusiëren, empathisch inlevenvermogen stimuleren

---

Assessment

How will you assess your students to ensure that learning outcomes are met?

1. **How will you assess your students?**

Ilse Mariën picked:

Assess the prototypes they created

---

2. **If "Other", pls state below.**

Ilse Mariën didn't give an answer

2

2. How many WEEKS do you anticipate the project to last for?

Ilse Mariën said:

4

3. How many HOURS overall do you anticipate the project to last for?

Ilse Mariën said:

8

Space

1. Will the project be delivered...?

Ilse Mariën picked:

Online

2. When in-person, where will students be located?

Ilse Mariën picked:

Classroom

3. If "other", state here.

Ilse Mariën didn't give an answer

4. When online, what tools will you use?

e.g., MS Teams, Zoom, moodle platform, online board

Ilse Mariën didn't give an answer

2. **Do students have any prior knowledge that could help them to take part in the project? If yes, explain below.**

Ilse Mariën said:

Jawel, door hun specifieke studiekeuze, tuinbouwtechnieken

3. **Can you describe the learning needs of your students?**

What are their learning strengths?

What are some learning challenges they face?

Do they have any special requirements?

Ilse Mariën said:

Ze kennen te weinig informatica om een goed spel te programmeren

4. **How will students be grouped?**

Ilse Mariën picked:

Based on student preferences

ExtenDT2: Activity plans for teachers by ExtenDT2

Discussion

Please sign in to add a comment.

Be the first to comment...

Appendix M

RECYCLING - DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Improving our recycling at school due to the new government regulations.

AUTHOR(S):

OU (31101)

ISSUE

Schools are not recycling packaging correctly; the Welsh government are looking to fine schools who are not recycling in line with government guidelines. Our school is now raising awareness and creating new labelled bins to ensure we are recycling correctly.

FINAL STUDENT PRODUCTION:

- Simulation game to share with other students to educate them on the correct ways to recycle.
- Feedback obtained from students who have played their games via the nQuire for students platform.

TECHNOLOGIES TO BE USED:

☐ MaLT2 + ChoiCo + SorBET ☐ VRobotics + NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Chemistry	Decide what recyclable materials go into the each bin.
Design Thinking & innovation with Emerging Technologies Related	
Prototyping	Create different SorBET games
Analysis	Interpret questionnaires answers to finalize the game
Reflecting & Feedback	Relate the feedback from their peers to iterations they did to the prototype

21st century Skills Related	
Communication	Explain their ideas to others.
	Discuss different solutions to the issue at hand.

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	12-13 years old
Prior knowledge	basic knowledge of programming concepts using scratch software. Some pupils used sorbet and nQuire last year.
Nationality, gender, cultural background	British, boys and girls.
Language	English
Special needs and abilities	-some have ASD and moderate learning difficulties

TIME

ACTIVITY DURATION: 6 hours,1 hour session

IMPLEMENTATION DURATION: 6 weeks

SCHEDULE: 1 hour/week

SPACE

ACTIVITY TYPE: + In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Science laboratory, classroom

VIRTUAL SPACE: n/a

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 28 NO OF GROUPS : 8 NO OF TUTORS: 1 NO OF ASSISTANTS: 1

STUDENT GROUPING & INTERACTIONS

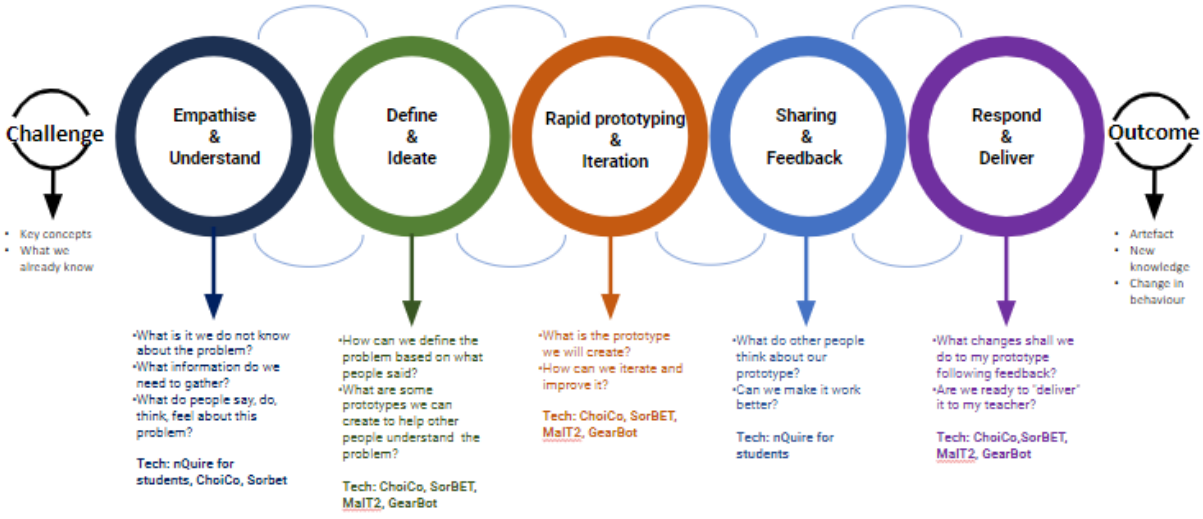
Grouping Criteria	mixed school performance, student preferences
Organisation	4 students per group using 1 computer per group
Roles in the group	Team leader, Research lead, Game designer, administrator.
Tutor(s) role(s)	intervene; monitor; facilitate; guide; observe

2.4 TEACHING RESOURCES

Digital resources	tutorials giving guidance on how to use the programs
Physical resources	n/a

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

The school has been highlighted by the Welsh Government that it isn't recycling correctly. Therefore, we are trying to identify the correct process to recycle used materials. They have a basic understanding of some recyclable materials, further awareness is required to ensure correct procedure is followed. These children need to gather information related to different groupings of recyclable materials.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In this phase students first discuss the issue with the teacher and asks questions related to recycling with each other to find their awareness on recycling. Students and teachers at the school at this phase. We will ask them what they say, do, think, feel about this problem. The problem can be addressed and rectified quite easily to ensure all staff and students are recycling correctly.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☒ No technology

STUDENTS' CONSTRUCTIONS: *e.g Online questionnaire*

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on the issue around recycling
Between the groups	Different groups do not interact during this phase

PHASE 2: DEFINE & IDEATE

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

They will play a SorBET game, be familiar with the functionalities of technology, define the parameters such as what pictures and images they will use while developing a game.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: Experiment with the existing procedures in sorbet

STUDENT CONSTRUCTIONS: -

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion and augmentation on the potential sorBET game
Between the groups	N/A

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: *, 2 SESSIONS *1 HOUR*

DESCRIPTION OF THE ACTIVITIES:

Students will create different games on SorBET and they will test them by playing it and decide finally which game to be shared for the feedback.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo + SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: SorBET games

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Students are to test their prototype between them and decide on a final design for other groups to use.
Between the groups	-

PHASE 4: SHARING & FEEDBACK

DURATION: *, 1 HOUR*

DESCRIPTION OF THE ACTIVITIES:

Students will design a set of questions in nQuire for students to collect feedback on the game they will have designed, they will share the link to the questionnaire and their game on the Teams to get feedback.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics + nQuire ☐ No technology

STUDENT CONSTRUCTIONS: nQuire mission

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion, Negotiation of what questions need to be included in the questionnaire. Reflecting upon the feedback from other users and using this to create their final product.
Between the groups	Sharing the prototype with other groups and obtaining feedback from them using NQuire.

PHASE 5:RESPOND & DELIVER

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES

Students will go through the feedback given by their classmates on their game. They will discuss amongst team members which ones to incorporate to make changes. Based on their consensus, they will make an amendment on their game and produce the final version.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo + SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion, Negotiation of what feedback to be considered while finalizing a game.
Between the groups	Different groups do not interact during this phase

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

General observation and oral assessment

APPROACH

Learning Outcome	Assessment Activity
Create a game on SorBET to deal with the issue of recycling	-Asking students at what stage they are at - Observing their work and giving suggestions on what they should do next

Appendix N

TYPES OF FORCES - DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Identifying types of forces and differentiating between balanced and unbalanced forces.

AUTHOR(S):

OU (231102)

ISSUE

Within the year 7 curriculum, students will need to know the fundamental basics of what forces are in the universe and how they contribute to or affect our everyday lives and existence. The year 7 pupils have started with the basics of forces where they need to understand the effect of the types of forces such as push, pull, twist or squeeze and the reaction from a balanced or unbalanced force e.g. acceleration, velocity etc.

FINAL STUDENT PRODUCTION:

- SorBET game to share with other students to educate them on the type of forces and whether a force is balanced or unbalanced.
- Feedback obtained from students who have played their games via the nQuire for Students platform.

TECHNOLOGIES TO BE USED:

☐ MaLT2 ☐ ChoiCo **X** SorBET ☐ VRobotics **X** nQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Mathematics	Using the SORBET game to compare calculations of forces and whether their answer deems them to be a balanced or unbalanced force.
Physics	Understanding of forces in the universe and their effects.
Design Thinking & innovation with Emerging Technologies Related	

Prototyping	Create a game prototype to decipher and test other students' knowledge on forces.
Analysis	e.g. Interpret questionnaires answers to redesign or modify the game they create.
Reflecting & Feedback	Relate the feedback from their peers to iterations they did to the prototype
21st century Skills Related	
Communication	Explain their ideas to others.
	Discuss different solutions to the issue at hand.
Presentation	Present their final artifact by demonstration

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	12-13 years old
Prior knowledge	basic knowledge of programming concepts using scratch software.
Nationality, gender, cultural background	British, boys and girls.
Language	English
Special needs and abilities	some have ASD and moderate learning difficulties

TIME

ACTIVITY DURATION: 6 hours divided into 1 hour sessions (min 6 hours - 6 sessions)

IMPLEMENTATION DURATION: 6 weeks

SCHEDULE: 1 hours/week

SPACE

Specify where the activity will take place

ACTIVITY TYPE: X In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Science laboratory, classroom

VIRTUAL SPACE: Teams to share their games, User IDs and so on

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 25 NO OF GROUPS : 9 NO OF TUTORS: 1 NO OF ASSISTANTS: 0

STUDENT GROUPING & INTERACTIONS

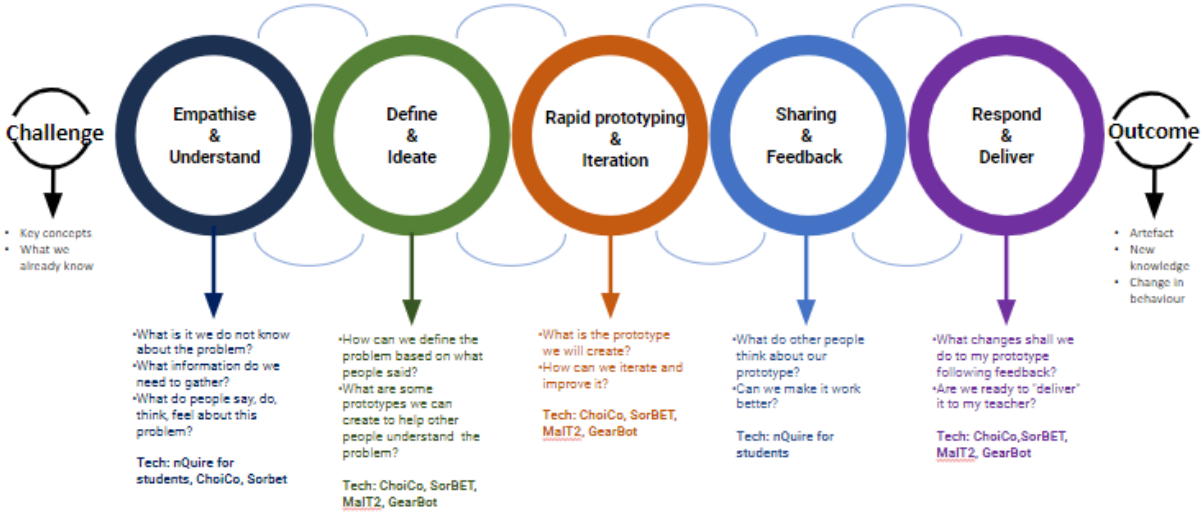
Grouping Criteria	mixed school performance, student preferences
Organisation	3 or 4 students per group using 1 computer per group
Roles in the group	Team leader, Research lead, Game designer, administrator.
Tutor(s) role(s)	intervene; monitor; facilitate; guide; observe

2.4 TEACHING RESOURCES

Digital resources	tutorials giving guidance on how to use the programmes
Physical resources	n/a

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

They will explore types of forces and whether a force is balanced or unbalanced. The related key concepts are identifying forces and their effects. They have a basic understanding of some forces, thus further awareness is required to continue the topic in to GCSE levels. They need to gather information related to the effect of forces.

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In this phase students will discuss the topic, types of forces given by the teacher. Then they will discuss with each other to explore more on this for their understanding.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo **X** SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on what are the types of forces and whether the force is balanced or not.
Between the groups	Different groups do not interact during this phase

PHASE 2: DEFINE & IDEATE

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

They will discuss what parameters they will consider while developing a game on SorBET in relation to types of forces.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: SorBET games

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussing on the parameters that can help to create a game
Between the groups	-

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION:2 sessions* 1 hour

DESCRIPTION OF THE ACTIVITIES:

In this stage, they will use SorBET to create prototypes (games) based on the parameters they have come up during the ideate and define stage. After creating the first version of the game, they play it to see if they need to modify further. They will make some iterations of the game based on their observation and each other's comments. They save several iterations on the Exten.(D.T.) 2 platform, and they will discuss further to agree on the final version to be shared across groups.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo **X** SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: MaLT2 3D models

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	They discuss what they need to improve on the games and agree on the final version to be shared across groups. They create several versions of the game.
Between the groups	

PHASE 4: SHARING & FEEDBACK

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

Students discuss what questions to incorporate in the survey they design on nQuire for students, create a mission and share the mission link and game link with their friends to collect feedback on their game.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo **X** SorBET ☐ VRobotics **X** NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion, Negotiation of what questions need to be included in the questionnaire
Between the groups	They also talk to other groups to give feedback on their game

PHASE 5:RESPOND & DELIVER

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES

Based on their friends' feedback they modify their games and download it as a final version and share it with Teams for everyone to play.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics **X** NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion, Negotiation of what questions need to be considered to modify the game
Between the groups	

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

My notes that include what stage they are at and what they are required to do further.

APPROACH

Learning Outcome	Assessment Activity
Creation of SorBET games that can help players understand types of forces and whether they are balanced or not	Review of students' final artefacts

Appendix O

ACCESS MATTERS! - DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Access Matters! Explore Inclusivity with Design Thinking

AUTHOR(S):

NTNU

ISSUE:

Accessibility means making sure that all people, no matter what their abilities are, can easily use and access places, services, and information. However, this is not always the case, even in public spaces that are important for our future society, such as schools and universities. Therefore, effort should be put into removing barriers to ensure an equal experience for everyone.

FINAL STUDENT PRODUCTION:

The outcome of the activity is a sustainable school/classroom planimetry (blueprint) from an accessibility point of view.

TECHNOLOGIES TO BE USED:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☒ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Social studies	Identify accessibility and inclusivity challenges in different personas and scenarios.
Social studies	Translate personas' accessibility challenges into the planimetry design to ensure an accessible school environment.
Programming	Illustrate the protagonist's (Vrobot) interaction in the GearsBot by coding the behaviour via block-based programming or phyton textual interface.
Programming	Demonstrate the validity of the created planimetry regarding accessibility by coding the Vrobot's behaviour using block-based programming or the Python textual interface.

Design Thinking & innovation with Emerging Technologies Related	
Prototyping	Create different prototypes of classroom/school layouts to improve their accessibility
Analysis	Interpret the feedback provided by their peers through nQuire
Reflecting	Transposition of the feedback given by their peers into the new design version of the school/classroom layout.
21st century Skills Related	
Communication	Explain the iterative process of designing a classroom/school layout and the changes/additions for each iteration
Evaluation	Verify the effectiveness of the designed classroom planimetry in terms of accessibility and inclusivity.
Evaluation	Justify the elements reported in the classroom planimetry to enhance accessibility and inclusivity and explain the reasoning behind improvements enacted.
Presentation	Present the improved version of the artefact (classroom planimetry) and the final version to the classroom.

2.2 PARTICIPANTS & CONTEXT

PLEASE ALSO REFER TO THE DOCUMENT:

STUDENTS

Age	11-12 years old
Prior knowledge	No prior knowledge is required
Nationality, gender, cultural background	International context. Most of the students can speak more than two languages. Almost all students have an international parent, namely not Norwegian. Class 1: 11 Boys, 9 Girls.
Language	English
Special needs and abilities	None

TIME

ACTIVITY DURATION: 6 hours divided into 2 times

IMPLEMENTATION DURATION: 2 days

SCHEDULE: 3 hours per day

SPACE

ACTIVITY TYPE: ✖ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Regular students' classroom

VIRTUAL SPACE: None (except for the ExtenDT2 platform)

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 20 students
NO OF GROUPS: 9 groups in total for this class
NO OF TUTORS: 2 main Facilitator. No of ASSISTANTS: 1 assistant (a researcher)

STUDENT GROUPING & INTERACTIONS

Grouping Criteria	The original class subdivision in pairs (or triads) determined the grouping criteria.
Organisation	2 students per group using 1 computer per group **(min 2, max 3 students/group)**
Roles in the group	Tasks are exchanged in the group without fixed roles. The roles are decided by the participants themselves according to their capabilities. (e.g., students more acquainted with programming took on operational roles while dealing with GearsBot) No roles have been pre-fixed to support the exchange of knowledge/skills (observing from the peer and then trying to put it into practice.)
Tutor(s) role(s)	Explain, guide, intervene on demand, facilitate, observe, and correct only if the students are off task ("correction" was kept open. E.g., the tutor brainstorms with the students to inspire them).

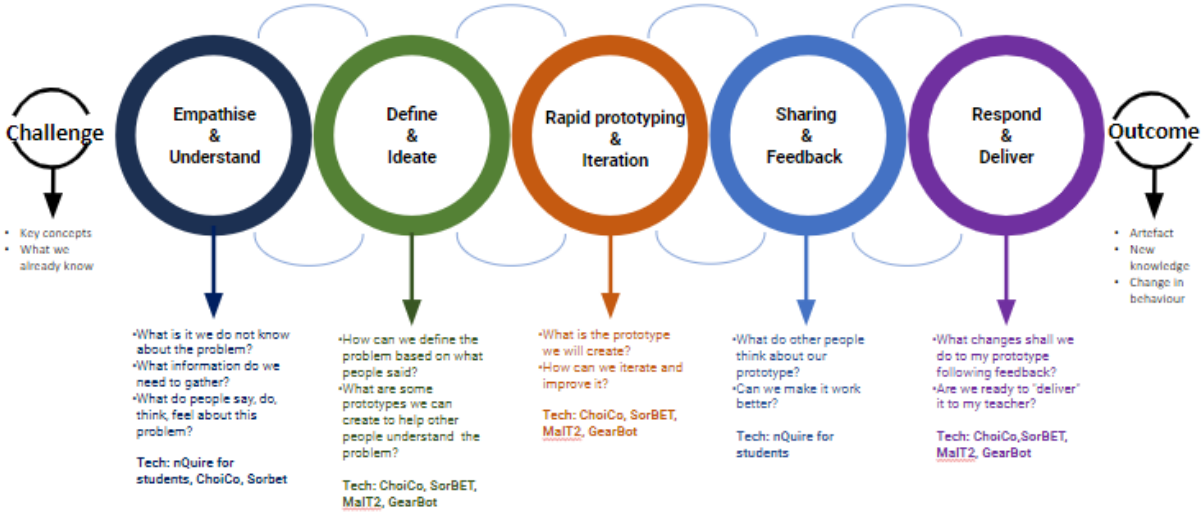
2.4 TEACHING RESOURCES

Digital resources	Template for the nQuire platform for peer assessment. Template for the GearsBot world (the paper-based school/classroom planimetry is scanned and uploaded by the teacher for a contextualised environment).

Physical resources	Paper-based personas cards, paper-based worksheets, paper-based teamwork assessment sheets.

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The activities described should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

The project addresses issues of inclusivity focusing on school accessibility.

PHASE 1: EMPATHISE & UNDERSTAND

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

As a first step, the teacher introduces the core concepts of “Inclusivity” and “Accessibility” with an interactive presentation. The Design Thinking strategy is also presented in all its steps. The participants are prompted to share their experiences to further elaborate on these concepts. A “deck of cards” with different user personas (the cards include in a brief description the needs, challenges, and opportunities based on real inclusivity/accessibility issues) is distributed to every group. After a brainstorming session internal to the group, the teammates are asked to come up with their very persona, namely the “protagonist” of their Design Thinking intervention. To support this passage, each group is provided with a first worksheet with prompts to guide the creation of their protagonist.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ✖ No technology

STUDENTS' CONSTRUCTIONS: *Group, paper-based worksheets*

STUDENTS' EXPECTED INTERACTIONS:

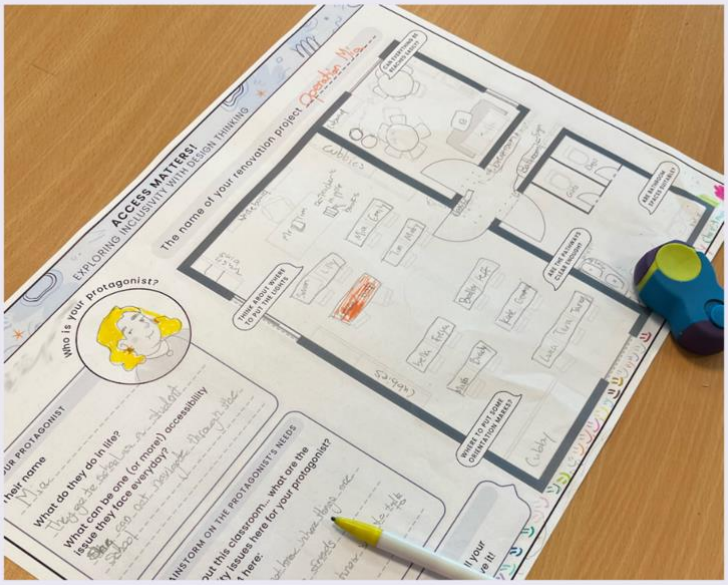
Between the members of the group	Discussion of previous experiences, notions, etc., related to inclusivity and accessibility to help in the interiorization/elaboration of the concepts. Collaboration in the choice of the protagonist's profiling.
Between the groups	The knowledge exchange should also happen at the class level when students are prompted to share their experiences, visions and perspectives on the topics.

PHASE 2: DEFINE & IDEATE

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

For this phase, participants will be provided with a planimetry template of school environments to be modified or created to ensure accessibility according to the protagonist's needs. Moreover, participants will receive information about the subsequent transposition of their filled template in the GearsBot (VRobotic) environment as an interactive setting, where the robot will metaphorically represent their protagonist.



At the end of the Define & Ideate phase, the groups request a round of feedback. The teacher provides the participants with the credentials to access a feedback form in nQuire. Each group exchanges their work with another group and proceeds to evaluate it, focusing on returning meaningful feedback for improvement.

For the first feedback, we employed the nQuire questionnaire at this link: https://learn.nQuire.org.uk/mission/access-matters-1

Once the feedback is exchanged, each group is asked to improve their classroom planimetry according to the peer assessment received on a new worksheet and to record/motivate the changes. After the changes are made, the teacher moderates a round of presentations, asking each group how they incorporated the feedback and how they enhance accessibility in their classroom planimetry.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ✖ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Group, paper-based worksheets and their improved versions, Feedback response.

STUDENTS' EXPECTED INTERACTIONS:

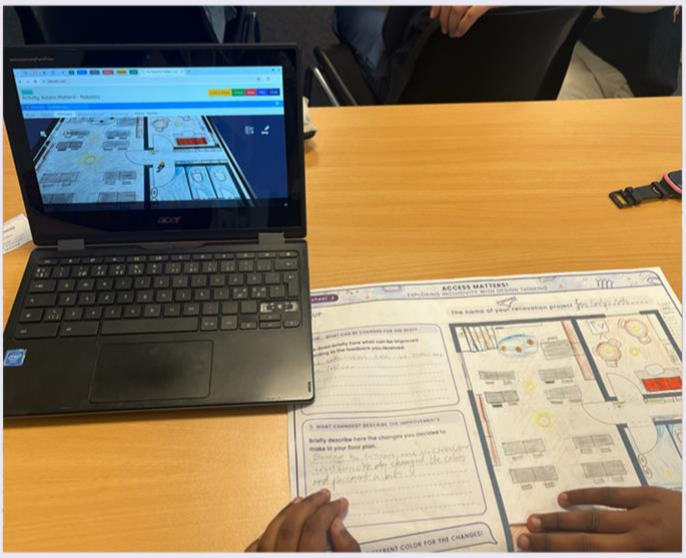
Between the members of the group	Collaboration in the creation of classroom planimetry and in its improvement. Multiple teammates can work on the same worksheet together.
Between the groups	Interaction among groups happens once worksheets are exchanged to provide feedback. Moreover, each group interacts with the rest of the classroom, presenting their improved version of the planimetry.

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: *1 and a half hours*

DESCRIPTION OF THE ACTIVITIES:

The teacher uploads the latest versions of the planimetry for each group onto the ExtenDT2 platform. This allows the groups to access a GearsBot world customised with their own classroom planimetry to contextualise the task better. The Vrobot is now the metaphor of the chosen protagonist. The facilitator proceeds by illustrating a brief tutorial on how to teach the robot to go straight on, turn right and turn left. Students are then asked to recreate the path of their protagonist in the GearsBot world by simulating interactions with the classroom environment, including furniture, lighting systems, and directional signs they designed. The movements of the Vrobot can be programmed via a block-based interface. If the pupils want, they can do the same task but increase the challenge using Python.



This exercise aims to identify any accessibility weak points in the designed planimetry that need correction. Students are asked to note down corrections on the paper-based planimetry. They can then request the teacher to upload a new version of their planimetry as an improved GearsBot world.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ✖ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Group, paper-based worksheets and their improved versions, GearsBot code.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Teammates work together in the coding activity with flexible roles. They can switch and change tasks at any time, covering various tasks such as block-based programming, Python programming, planimetry improvement on paper, and guiding the implementation of the Vrobot's behaviour.
Between the groups	Participants do not interact between groups during this step.

PHASE 4: SHARING & FEEDBACK

DURATION: *1 hour*

DESCRIPTION OF THE ACTIVITIES:

Once the Vrobot's path has been coded to explore the accessibility of the classroom environment, the students exchange their creations within their groups. After playing the GearsBot game coded by another group and discussing it internally, each group accessed nQuire for another round of feedback focused on the planimetry's accessibility and the quality of Vrobot's coded behaviour.

Finally, the groups are prompted to discuss the feedback received with their teammates and then

proceed to refine their prototypes by improving both the planimetry (a third worksheet is provided by the teacher) and the code. Students are asked to elaborate on the feedback by reasoning whether they agree or disagree. For the first feedback, we employed the nQuire questionnaire at this link: https://learn.nQuire.org.uk/mission/access-matters-1

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ✖ VRobotics ✖ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Group, paper-based worksheets and their improved versions, GearsBot improved code, Feedback response.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Team members test the GearsBot code of another group and work together on how to answer the feedback survey properly. Discussion on what/how to implement the feedback received by peers.
Between the groups	Interaction among groups happens once worksheets are exchanged to provide feedback.

PHASE 5: RESPOND & DELIVER

DURATION: 30 minutes

DESCRIPTION OF THE ACTIVITIES

All the groups are asked to summarise their Design Thinking journey with a presentation. In the presentation, each group should state their protagonist, their planimetry, their experience in implementing it with GearsBot, and how it improved (or not!) according to the feedback received by the other groups.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ✖ No technology

STUDENT CONSTRUCTIONS: *Finalized planimetry worksheet.*

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Team members work together on their finalised version of the planimetry by preparing a presentation.
Between the groups	Groups interact with each other during the presentation with comments and questions. Feedback received, interpretation, and implementation are possibly discussed between groups.

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Rubrics should be used to evaluate students' worksheets and observer notes focused on single groups. Moreover, the researcher should access the answers to the two nQuire questionnaires. The artefacts supported on the Gearsbot platform can be accessed, specifically the coding interface.

APPROACH

Learning Outcome	Assessment Activity
Identify accessibility and inclusivity challenges in different personas and scenarios.	Worksheets review, specifically worksheet number 1. The analysis should address the first worksheet's points on the personas' creation and profiling.
Translate personas' accessibility challenges into the planimetry design to ensure an accessible school environment.	Worksheets review, specifically worksheet number 1. The analysis should access the group's contribution to the planimetry template.
Illustrate the protagonist's (Vrobot) interaction in the GearsBot by coding the behaviour via block-based programming or phyton textual interface.	Analysis of the group artefact supported by the Virtual robot platform (Vrobot), specifically analysis conducted on the outcome from the block-based coding activity.
Demonstrate the validity of the created planimetry regarding accessibility by coding the Vrobot's behaviour using block-based programming or the Python textual interface.	Worksheets review, specifically worksheet number 2. **+** Analysis of the group artefact supported by the Virtual robot platform (Vrobot), specifically analysis conducted on the outcome from the block-based coding activity.
Create different prototypes of classroom/school layouts to improve their accessibility.	A worksheet review, specifically an analysis, should be conducted to determine the similarities/differences between worksheets 1, 2, and 3 to understand the evolution of the design.
Interpret the feedback provided by their peers through nQuire.	A review with the support of a rubric should be employed to evaluate teams' responses when their peers are evaluated on the base of their work (e.g., the structure of the feedback).
Transposition of the feedback given by their peers into the	A worksheet 2 review and a Vrobotics outcome review should be conducted in parallel with the feedback received via nQuire.

new design version of the school/classroom layout.	
Explain the iterative process of designing a classroom/school layout and the changes/additions for each iteration.	Similar to the objective "Create", a worksheet review, specifically an analysis, should be conducted to determine the similarities/differences between worksheets 2 and 3 to understand the evolution of the design + analyse the communicative effort (is the planimetry understandable by others outside the group?) in creating the design.
Verify the effectiveness of the designed classroom planimetry in terms of accessibility and inclusivity.	A worksheet review on worksheets 1, 2, and 3. + Conduct an analysis of the feedback between groups to understand if the pupils reflected critically on others' creations.
Justify the elements reported in the classroom planimetry to enhance accessibility and inclusivity and explain the reasoning behind improvements enacted.	A worksheet review on worksheets 1, 2, and 3. Observer notes should be considered while participants discuss why they implemented specific design choices (e.g., is this element from in-group elaboration or external feedback from another group/facilitator).
Present the improved version of the artefact (classroom planimetry) and the final version to the classroom.	Analysis was conducted on the observer notes taken during the in-class presentation.

Appendix P

BECOME A MASTER OF RECYCLING – DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Become a master of recycling!

AUTHOR(S):

NTNU

ISSUE:

Sustainability is implemented in a coding activity, where the students are supposed to block-code a solution for the robot to recycle garbage. The overall activity is supported by both nQuire and GearsBot (also referred as Vrobots/Vrobotics) The project, therefore, aims to shed light on sustainability and improve the children's coding competence.

FINAL STUDENT PRODUCTION:

A block-coding solution that successfully recycles garbage items.

TECHNOLOGIES TO BE USED:

MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☒ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Mathematics	Use mathematics to compute the climate points based on an algebraic function as well as computations necessary for the block coding
Computational thinking	Solve the problem by utilizing block coding; in order to do this, computational thinking is necessary to actuate a problem-solving strategy. Multiple quests are proposed to the group, there is no one-way solution to achieve via coding blocks.
Design Thinking & Innovation with Emerging Technologies Related	

Prototyping	Create and try out different solutions in the GearsBot platform. The process is iterative towards a more and more refined (in this case, efficient!) solution.
Analyze & Define	Interpret and understand the problem that needs to be solved, which will be done in the define stage. Done through interpretation of the questions and video during the empathies stage.
Reflecting & Feedback	Done through testing of the solution with another group. This includes feedback to another group as well as reflecting on one's own work. The received feedback will be interpreted and guide the improvement of the solution.
Ideate	Ideate different solutions when given the map. Multiple different solutions can be implemented (shortest path? Most effective path in collecting the litter, but longer, etc.).
21st century Skills Related	
Communication	Explain their ideas to others, both within the group and with other groups, especially in the feedback task and in the presentation task. Discuss different solutions with the other team members.
Computational thinking and technical skills	Coding through the platform will improve both the technical skills and computational thinking, which are both two important skills in this century
Presentation	Present their final artefact by demonstration to another group

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	13-14 years old
Prior knowledge	basic knowledge of programming
Nationality, gender, cultural background	Mostly Norwegian, 1 Italian, 28 boys & 17 girls (from the pre-questionnaire)
Language	Mostly Norwegian

Special needs and abilities	Not present / not disclosed

TIME

ACTIVITY DURATION: 7 hours into 3 days

IMPLEMENTATION DURATION: 3 days

SCHEDULE: 2-3 hours per day, 3 days in total

SPACE

ACTIVITY TYPE: ☒ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Classroom (the one the class employ for the regular schedule)

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 45 No of GROUPS: 22 No of TUTORS: 3 No of ASSISTANTS: 1

STUDENT GROUPING & INTERACTIONS

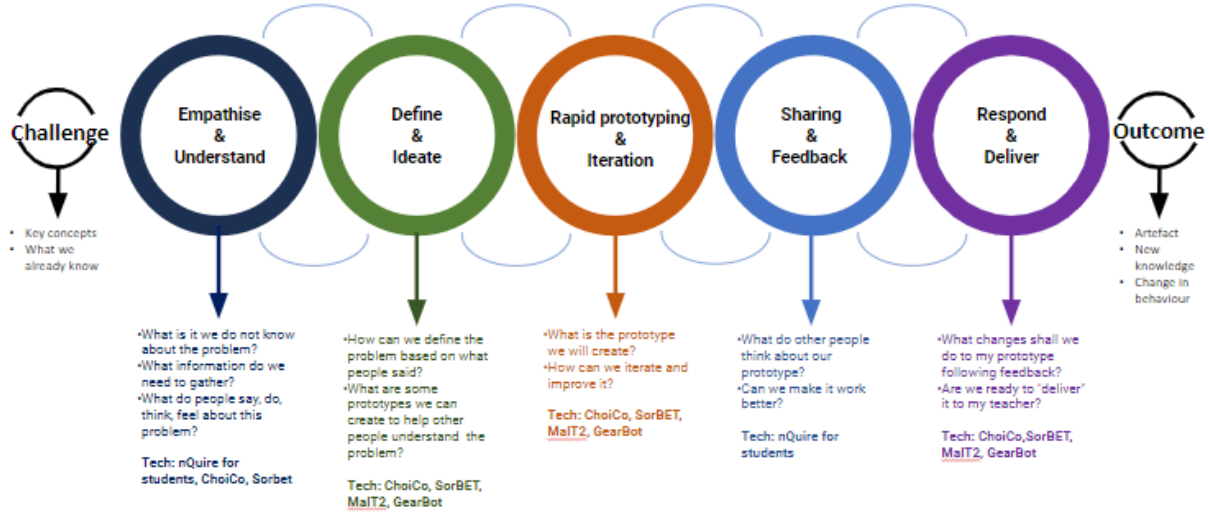
Grouping Criteria	The teacher allocated students in dyads and triads based on her knowledge of the students. Dyads were prioritized.
Organization	from 2 to 3 students per group using 1 computer per group
Roles in the group	No specific roles. The subdivision of tasks occurs naturally according to teamwork management by students.
Tutor(s) role(s)	teach; intervene; monitor; facilitate; guide; observe; observe the teacher dashboard

2.4 TEACHING RESOURCES

Digital resources	GearsBot for the prototyping and nQuire to support the feedback delivery after the testing.
Physical resources	Printed Emphatize Questions and Printed Ideate Map

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Through the GearsBot platform, the children are presented with a problem where they are supposed to implement block-based coding that allows them to move objects around. These objects are designed to address the recycling problem under the sustainability theme, where the children need to implement coding that allows them to recycle the objects correctly. A basic understanding of the recycling problem and basic coding knowledge is necessary.

PHASE 1: EMPATHISE & UNDERSTAND

DURATION: *1 hour*

DESCRIPTION OF THE ACTIVITIES:

The empathise phase aimed to engage students with sustainability and encourage a deeper understanding of environmental issues. Developed through collaboration between researchers, an expert, and a teacher, this phase involved multiple elements to foster empathy. Initially, students watched a short educational sustainability video focusing on recycling. This was followed by a classroom discussion where students reflected on their habits, as presented in the video, and considered improvements for environmental impact.

Subsequently, the students completed a questionnaire that included tasks related to sustainability. This activity was designed to make the problem more relatable and deepen their knowledge of the topic. Questions were first answered individually and then discussed in groups. An innovative aspect of this phase was integrating mathematics by having students calculate their "climate points" based on daily habits like transportation choices and recycling behaviours. These points were averaged within

groups and shared with the class to facilitate a comparison of behaviours and to understand different environmental impacts.

Overall, the empathise phase was structured to help students relate personally to sustainability issues, encouraging them to identify and modify their habits for better environmental outcomes.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☒ No technology

STUDENTS' CONSTRUCTIONS: Questionnaire and answers, supported by paper-based material

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion of their habits and their family's habits, both at the in-group and with a facilitator.
Between the groups	Discussion of what good habits they have and what habits to improve at the classroom level.

PHASE 2: DEFINE & IDEATE

DURATION: *1 hours*

DESCRIPTION OF THE ACTIVITIES:

Define: The define stage in the design thinking process focused on identifying specific environmental problems that students could address through block-coding. This stage was directly influenced by the findings from the empathise phase, where students reflected on their sustainability habits and behaviours. The challenge in this stage was to work within the constraints of the pre-existing Gearsbot system, which limited the range of possible problems to those solvable via block coding.

Given these constraints, it was essential for the researchers to guide students effectively to ensure that the problems identified were both relevant and feasible. Each group of students analysed their answers from the empathize phase questionnaire to identify one significant environmental issue based on their daily habits. Common issues identified included the need to increase recycling efforts, adopt more vegetarian eating habits, and reduce car usage.

Once each group defined their problem, they shared it with the rest of the class. This sharing not only fostered a collaborative environment but also helped all students gain a broader understanding of the various environmental challenges their peers were focusing on. Thus, the define stage served as a critical bridge between personal reflection and the design thinking process's upcoming stages of solution development.

Ideate: The ideate stage in the design thinking process was creatively structured around the Gearsbot platform, integrating both physical and digital elements to stimulate the students' engagement and creativity. Having defined their environmental problems in the previous stage, students moved to brainstorm and develop solutions using a tangible and familiar context.

The central tool for ideation was a printed map of a world that incorporated elements from the students' own city, enhancing the relevance and connection to their daily lives. This map featured various "garbage" items scattered across it, each coloured to match the corresponding recycling bin. The task for the students was to design a solution using block coding to direct a robot to pick up these items and dispose of them correctly.

To facilitate this, each group received a copy of the map to plot out their ideas physically. They were encouraged to draw their routes for the robot, utilising different colours to denote various recycling paths. This tangible activity was mirrored in a digital version on the Gearsbot platform, where they would implement the same solutions, they had developed on paper.

This stage was particularly engaging because it combined hands-on activity with the critical thinking required for block coding. It allowed students to experiment with different solutions in a playful yet structured environment. The challenge varied depending on the nature of the problem identified—whether it was recycling more efficiently, driving less, or promoting vegetarian eating, with the latter sometimes requiring additional guidance to refocus on feasible solutions involving recycling.

As a result, the ideate phase deepened the students' understanding of environmental issues and enhanced their problem-solving skills by connecting conceptual ideas with practical implementation. This led to lively interactions among the groups, with some students eagerly comparing and defending the superiority of their solutions, demonstrating a high level of engagement and enthusiasm for the task.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☒ No technology

STUDENTS' CONSTRUCTIONS: Questionnaire and answers, both paper-based

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Group's members collaborative work together to reach a defined solution to the problem.
Between the groups	Sharing their solution with each other and comparing them among groups after briefly present it to the classroom.

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: *3 hours*

DESCRIPTION OF THE ACTIVITIES:

The prototyping phase in the design thinking process was centred around the practical application and hands-on experimentation using the GearsBot platform. This phase transitioned from conceptualising solutions to actual implementation, focusing on the interactive and technical aspects of coding.

Initially, the session began with a brief review of the design thinking steps covered so far, refreshing the students' memory and reinforcing the project's continuity. Students were encouraged to engage

actively by recalling what they had learned in previous sessions. This recap was crucial for contextualising their daily tasks and ensuring that the knowledge from earlier phases was effectively applied.

The prototyping involved the students working in the same groups as before, each group sharing one computer. This setup fostered collaboration and shared problem-solving responsibilities. The primary task for each group was to code the robot to perform specific functions that were directly related to the environmental solutions they had envisioned during the ideate phase. Specifically, the students were tasked with programming the robot's magnetic function to pick up items designated for recycling on the map they had previously drawn.

The hands-on coding was an extension of their homework, which involved familiarising themselves with the GearsBot platform and experimenting with making the robot drive autonomously. This step-by-step buildup of skills was designed to empower the students to implement the solutions they had initially conceptualised and mapped out.

By working directly with the code and the physical robot, students could see the tangible outcomes of their designs, making adjustments and improvements as needed. This phase deepened their understanding of how their solutions could be applied in real-world scenarios. It highlighted the practical challenges and satisfactions of bringing a digital concept into physical realisation.

EXPECTED USE OF EXTENDT2 TECHNOLOGY: GearsBot (VRobotics)

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☒ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Block-based Coding in the GearsBot platform

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Teamwork and working on the code and solution together. The team members collaborate together on a single device, and they have to find a good balance (take turns, split tasks, communicate effectively, etc.)
Between the groups	No among group collaboration.

PHASE 4: SHARING & FEEDBACK

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

The activity during the testing phase involved groups of students evaluating each other's projects using the nQuire platform. Each group presented their block-coded robot solution, which they had developed to address specific environmental issues identified earlier in the project. After each presentation, the groups used the nQuire platform to assess each other's work based on a set of given criteria.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☒ NQuire ☐ No technology

At the following link, it is possible to access the nQuire "mission" employed:
https://learn.nQuire.org.uk/mission/bli-en-baerekraftsmaster/data

STUDENT CONSTRUCTIONS: Feedback form filled via nQuire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Working together to deliver feedback. + Finalize their solution. Team members have to reach a shared understanding of the feedback they received from another group and decide to how to improve their solution according to it.
Between the groups	Evaluate each other and give feedback.

PHASE 5:RESPOND & DELIVER

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES

This peer evaluation allowed students to engage critically with the solutions proposed by their classmates, fostering a deeper understanding and application of the concepts they had learned throughout the design thinking process. After the presentation, groups were asked to critically elaborate on their experience and if they felt they build the solution as they expected.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☒ No technology

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Student pre- and post-quiz, students solution, evaluation rubric on the students' solution, paper-based materials from the students, as well as the students' block-coding solution. Moreover, observations are gathered.

APPROACH

Learning Outcome	Assessment Activity
Use mathematics to compute the climate points based on an algebraic […].	Review the paper-based material filled out by the group.

Solve the problem by utilizing block coding; in order to do this, computational thinking […].	Review the coding delivery through an evaluation rubric with a focus on the block based interface, or, alternatively, the Python interface if the group decided to program the solution with it. Different dimensions can be addressed: correctness, efficacy, creativity, etc.
Create and try out different solutions in the GearsBot platform […].	Review the coding delivery and its multiple versions by accessing the GearsBot platform timestamps.
Interpret and understand the problem that needs to be solved, which will be done in the define stage. […].	Review the paper-based material filled out by the group.
Done through testing of the solution with another group. […].	An analysis on the feedback given should be conducted by accessing the nQuire responses. Moreover, the researcher should access the pre-feedback artifact's version and compare it with the post-feedback artefact's version via the GearsBot's platform timestamps.
Ideates different solutions when given the map […].	Review the paper-based material filled out by the group, specifically the A3 map.
Explain their ideas to others, both within the group and with other groups […]. Discuss different solutions with the other team members.	Observation notes are crucial to gather information on this passage, especially during the presentation activity. Pupils need to adjust their communication to the class, to deliver a clear message about their solution.
Coding through the platform will improve both the technical skills and computational thinking […].	As the "Solve" skill: review the coding delivery through an evaluation rubric with a focus on the block based interface, or, alternatively, the Python interface if the group decided to program the solution with it.
Present their final artefact by demonstration to another group.	Observation notes on the discussion between groups prompted by the presentation + follow up qiestions.

Appendix Q

DAILY ADVENTURES WITH AI -DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

DAILY ADVENTURES with AI: A machine Learning workshop. Discover more about Artificial Intelligence with Design Thinking.

AUTHOR(S):

NTNU

ISSUE:

Design thinking is a problem-solving approach, and we will use design thinking to solve everyday problems by creating machine learning (ML) and artificial intelligence (AI) solutions, refining them, and finally testing them.

FINAL STUDENT PRODUCTION:

The result of the activity is a game developed on the SorBET platform. Through the game, the students create a classification of items (namely, a database) that need to be "fed" to the AI to resolve the protagonist's problems.

TECHNOLOGIES TO BE USED:

Select the ExtenDT2 technologies that will be used by students during the DT Project

☐ MaLT2 ☐ ChoiCo ✖ SorBET ☐ VRobotics ✖ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Social studies	Identify possible challenges in different personas and scenarios from their everyday life. In this case, the challenge does not have to be connected to ML, AI, or generated by these tools. The students will employ ML and AI's affordances to solve the personas' difficulties.
Social studies	Translate personas' everyday challenges into the storyboard to contextualise their difficulties and resulting needs and to elaborate storytelling.

Programming	Illustrate the composition of the "Database" (the items chosen to be classified) by coding the gameplay rules and dynamics of the sorting game SorBET via block-based programming.
Programming	Demonstrate the validity of the "Database" classification by coding the gameplay rules and dynamics using the SorBET block-based programming interface.
Design Thinking & Innovation with Emerging Technologies Related	
Prototyping	Create different prototypes of "Database" classification of items to improve the understanding of data feed to the ML model.
Analysis	Interpret the feedback provided by their peers through the nQuire form and the paper-based feedback form.
Reflecting	Transposition of the feedback given by their peers into their persona's profile, storyboard, and "Database" artefact on SorBET.
21st-century Skills Related	
Communication	Explain the iterative process of designing a "Database" representation of their ML and AI solution.
Evaluation	Verify the effectiveness of the designed "Database" regarding consistency with the solution and fairness.
Evaluation	Justify the elements reported in the "Database," specifically the items chosen to be embedded in the database and their classification, as well as the categories chosen.
Presentation	Present the narration (supported by the worksheet storyboard) to the classroom to contextualise the problem space.

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	13-14 years old
Prior knowledge	No prior knowledge is required
Nationality, gender, cultural background	Norwegian school setting. Here, students may come from various backgrounds and nationalities, but most have lived their whole lives in Norway and have

	Norwegian-speaking parents. In class 1, 10 Boys, 13 Girls, 1 Other + in class 2, 11 Boys, 15 Girls, 1 Other.
Language	Norwegian (students also communicate in English)
Special needs and abilities	A small minority of the students follow an individual education plan

TIME

ACTIVITY DURATION: 6 hours divided into 2 different sessions

IMPLEMENTATION DURATION: 2 days

SCHEDULE: 3 hours per day

SPACE

Specify where the activity will take place

ACTIVITY TYPE: ✖ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Regular students' classroom

VIRTUAL SPACE: None (except for the ExtenDT2 platform)

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 24 (Class 1) + 27 (Class 2)

NO OF GROUPS: 19 groups in total / 9 groups in Class 1 + 10 groups in Class 2 (vary during the two days)

NO OF TUTORS: 1 main Facilitator. NO OF ASSISTANTS: 2 assistants.

STUDENT GROUPING & INTERACTIONS

Grouping Criteria	The initial class subdivision into pairs (or triads) was based on the arrangement of the classroom desks that were already present. However, the teacher may intervene to make specific arrangements to promote better collaboration and conflict avoidance.
Organisation	2 students per group using 1 computer per group (min 2, max 3 students/group)

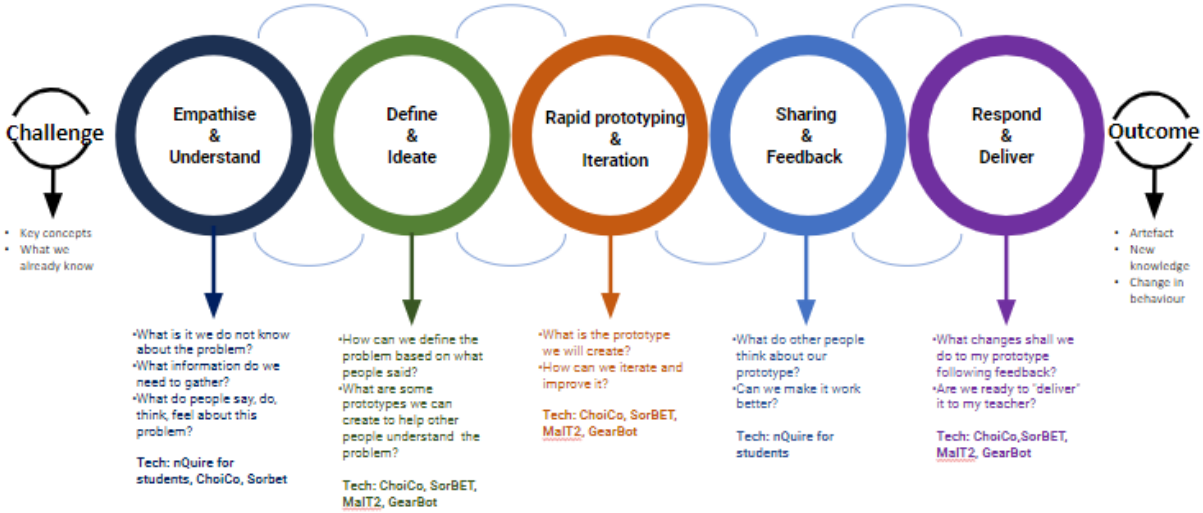
Roles in the group	Tasks are exchanged in the group without fixed roles. The roles are decided by the participants themselves according to their capabilities. (e.g., students familiar with block-based programming took on operational roles while dealing with SorBET) No roles have been pre-fixed to support the exchange of knowledge/skills (observing from the peer and then trying to put them into practice.)
Tutor(s) role(s)	Explain, guide, intervene on demand, facilitate, observe, and correct only if the students are off task ("correction" was kept open. E.g., the tutor brainstorms with the students to inspire them).

2.4 TEACHING RESOURCES

Digital resources	Template for the nQuire platform for peer assessment. Template for the SorBET activity.
Physical resources	Paper-based personas cards, paper-based worksheets, paper-based peer assessment sheets.

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The activities described should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Discover more about Artificial Intelligence with Design Thinking.

PHASE 1: EMPATHISE & UNDERSTAND

DURATION: *1 hour*

DESCRIPTION OF THE ACTIVITIES:

As a first step, the teacher introduces the core concepts of Machine Learning (ML), Artificial Intelligence (AI) and "Accessibility" with an interactive presentation. The Design Thinking strategy is also presented in all its steps. The participants are prompted to share their experiences to further elaborate on these concepts. A "deck of cards" with different user personas (the cards include a brief description of the needs, challenges, and opportunities based on real inclusivity/accessibility issues) is distributed to every group. After a brainstorming session internal to the group, the teammates are asked to develop their very persona, namely the "protagonist" of their Design Thinking intervention. To support this passage, each group is provided with a first worksheet with prompts to guide the creation of their protagonist.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ✖ No technology

STUDENTS' CONSTRUCTIONS: Group, paper-based worksheets

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion of previous experiences, notions, etc., related to inclusivity and accessibility to help in the interiorization/elaboration of the concepts. Collaboration in the choice of the protagonist's profiling.
Between the groups	The knowledge exchange should also happen at the class level when students are prompted to share their experiences, visions and perspectives on the topics.

PHASE 2: DEFINE & IDEATE

DURATION: *2 hours*

DESCRIPTION OF THE ACTIVITIES:

Participants are given a protagonist template to fill out for this phase. This template will help them explore the protagonist's relationship with technology, their daily issues, and opportunities for solutions. Afterwards, each group receives another worksheet to sketch a storyboard illustrating how AI and ML can solve their protagonist's issues, reflecting on the trustworthiness of the outcome. Participants will also receive information about transposing their ideas into the SorBET game. In this game, the interactive metaphor for a database will be used, where the sorting game dynamics represent a classification that should be fed to an ML model designed to solve the challenges of the chosen protagonist.

At the end of the Define & Ideate phase, the groups were engaged in a round of feedback. The teacher gives the participants the credentials to access a feedback form in nQuire. Each group exchanges their

work with another group and proceeds to evaluate it, focusing on returning meaningful feedback for improvement.

Once the feedback is exchanged, each group is asked to improve both worksheets based on the peer assessment received. After making the changes, the teacher moderates a round of presentations. During these presentations, each group summarises their initial ideas (protagonist and storyboard) and explains how they elaborated on and incorporated the feedback received.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ✖ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Group, paper-based worksheets and their improved versions, Feedback response.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Collaboration among group members involves profiling the chosen protagonist, identifying their challenges and opportunities, and developing solutions. They also work together to narrate the solutions unfolding via the storyboard. Multiple teammates can work on the same worksheet simultaneously.
Between the groups	Interaction among groups occurs when they exchange worksheets to provide feedback. Additionally, each group interacts with the rest of the class by presenting their improved version of the persona's profiling and the storyboard of the challenge.

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 1 and a half hours

DESCRIPTION OF THE ACTIVITIES:

The students use a shared group account to access the ExtenDT2 platform, where they find the SorBET template prepared by their teacher. The teacher explains that the inserted items and their classifications serve as a metaphor for a machine learning database, which is, essentially, a large collection of examples used to train the machine to perform sorting tasks independently. Each group is then tasked with applying what they've learned in the previous steps: using the database to help solve their protagonist's problems.

As a second step, the students are asked to internally test their classification by trying out SorBET. Block-based programming rules are briefly explained, and groups are expected to refine their prototype until they reach an optimal classification and gameplay.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ✖ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: *SorBET classification and code.*

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Teammates collaborate on the classification and coding activity with flexible roles, allowing them to switch and change tasks at any time. They engage in various tasks such as block-based programming, transposing ideas from the previous Design Thinking steps, and guiding the research and selection of items.
Between the groups	Participants do not interact between groups during this step.

PHASE 4: SHARING & FEEDBACK

DURATION: *1 hour*

DESCRIPTION OF THE ACTIVITIES:

The students exchange their creations within their groups. After playing the SorBET game coded by another group and discussing it internally, each group employs a small paper-based questionnaire to provide feedback on the other group's artefact, focusing on the consistency of the chosen topic and the code quality.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ✖ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: Group, paper-based worksheets and their improved versions, GearsBot improved code, Feedback response.

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Team members test another group's artefact (supported on SorBET) and work together on how to answer the paper-based feedback survey properly. Discussion on what/how to implement the feedback received by peers.
Between the groups	Interaction among groups happens once devices used to create the SorBET artefact are exchanged to provide feedback.

PHASE 5:RESPOND & DELIVER

DURATION: 30 minutes

DESCRIPTION OF THE ACTIVITIES

All the groups are asked to summarise their Design Thinking journey with a brief presentation, specifically focusing on the latest feedback given by another group. In the presentation, each group quickly summarised the aim of their overall work, addressing how the feedback helped them (or not!)

better understand the flaws or strengths of their design. Finally, the groups is asked if, with this Design Thinking journey, were effectively able to solve their protagonist's problem.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ✖ No technology

STUDENT CONSTRUCTIONS: *Finalized planimetry worksheet.*

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Team members work together to understand the feedback received by their peers and to prepare the feedback commentary.
Between the groups	Groups interact with each other during the presentation with comments and questions. Feedback received, and its interpretation is topics discussed between groups.

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Rubrics were used to evaluate students' worksheets; rubrics were used to evaluate students' responses from nQuire feedback templates; rubrics were used to analyse SorBET artefact (namely, the "Database" creation); observer notes were focused on single groups.

APPROACH

Learning Outcome	Assessment Activity
Identify possible challenges in different personas and scenarios from their everyday life [...].	Worksheet evaluation, specifically the first actions required on worksheet number 1.
Translate personas' everyday challenges into the storyboard to contextualise their difficulties and resulting needs and to elaborate storytelling.	Worksheet evaluation, specifically the first actions required for the last prompts on worksheet number 1 and the storytelling activity supported by worksheet number 2.
Illustrate the composition of the "Database" (the items chosen to be classified) by coding the gameplay rules [...].	The rubric should be applied to the SorBET artefact, paying attention to the classification table and the arrangement of the coding blocks.
Demonstrate the validity of the "Database" classification by coding the gameplay rules and dynamics using the SorBET	As for the "Illustrate" skill, the rubric should be applied to the SorBET artefact, paying attention to the classification table in connection with the topic chosen, the persona created and the scenario narrated in the previous worksheets.

block-based programming interface.	
Create different prototypes of "Database" classification of items to improve the understanding of data feed to the ML model.	As for the "Illustrate" and the "Create" skill, the rubric should be applied to the SorBET artefact, paying attention to the classification table in connection with the topic chosen, the persona created and the scenario narrated in the previous worksheets.
Interpret the feedback provided by their peers through the nQuire form and the paper-based feedback form.	Students present their interpretation of feedback changes made at the end of the activity, in front of the class. Observers' notes can capture such informations. For a better contextualisation of the changes made, the researcher should also access the feedback from nQuire + from the paper-based questionnaire provided by the other group.
Transposition of the feedback given by their peers into their persona's profile, storyboard, and "Database" artefact on SorBET.	Evaluation of both worksheets (number 1 and 2). As for the "Interpret" skill, for a better contextualisation of the changes made, the researcher should also access the feedback from nQuire + from the paper-based questionnaire provided by the other group.
Explain the iterative process of designing a "Database" representation of their ML and AI solution.	Present the idea to their peers and design the artifact in SorBET with the objective that it must be understandable and intuitively connected to the chosen scope. Observers' notes can capture such informations.
Verify the effectiveness of the designed "Database" regarding game-play, consistency with the solution, and fairness.	Worksheet evaluation (both 1 and 2) in comparison with the SorBET artefact. Moreover, the artifact can be evaluated in terms of "game-play efficacy" (was it understandable to pupils outside the group?) based on the block-based code and the clarity of the textual labels/images chosen to be uploaded.
Justify the elements reported in the "Database," specifically the items chosen to be embedded in the database and their classification and the categories chosen.	Each group provide motivations about their design choices when the artifacts are exanched between groups. Moreover, groups comment on the feedback received in the last design Thinking session. Discussions on different perspectives can arise, since one of the topic of the activity is understanding the concept of "bias" in ML databases. Observers' notes can capture such informations.
Present the narration (supported by the worksheet storyboard) to the classroom to contextualise the problem space.	Analysis was conducted on the observer notes taken during the in-class presentation.

Appendix R

THE BEEKEEPERS' GAME -DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

The Beekeepers' game

AUTHOR(S):

NKUA (implemented by LNU)

ISSUE:

One of the big issues related to environmental sustainability during recent years is the decline of bees' population. Consequently, scientists emphasize the importance of protecting their population, and beekeepers are those who lead the way, facing various difficulties in maintaining their beehives healthy.

FINAL STUDENT PRODUCTION:

Students develop a ChoiCo game about suitable spots where beekeepers can move their beehives taking into account bees' needs and factors that put beehive's well being in danger.

TECHNOLOGIES TO BE USED:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Environmental sustainability	• Recognize beehives' problems and needs • Explain the suitability of a geographical location for beehives wellbeing
Geography	• Decide on places suitable for beehives • Use geographical coordinates to refer to specific locations • Recognize the relationship between a geographical location and its climate conditions

Design Thinking & innovation with Emerging Technologies Related	
Prototyping	• Create different prototypes of ChoiCo games • Interpret questionnaires answers to design criteria for the game they create.
Empathizing	• Identify beekeepers' problems and beehives' needs
Feedback and testing	• Relate the feedback from their peers and beekeepers to iterations they did to the prototype
21st century Skills Related	
Communication	• Explain their ideas to others.
Presentation	• Present their final artifact by demonstration

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	14-15 years old
Prior knowledge	none or basic knowledge of block programming
Nationality, gender, cultural background	Swedish
Language	Swedish
Special needs and abilities	-

TIME

ACTIVITY DURATION: 7 sessions of 1h and 15 min each (total duration approximately 9 hours)

IMPLEMENTATION DURATION: 4 weeks

SCHEDULE: 1-2 sessions per week

SPACE

Specify where the activity will take place

ACTIVITY TYPE: + In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: computer laboratory

VIRTUAL SPACE: -

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

No of STUDENTS: 76(divided in 3 classes) No of GROUPS : 19 (6+6+7) No of TUTORS: 1 No of ASSISTANTS:1-2

STUDENT GROUPING & INTERACTIONS

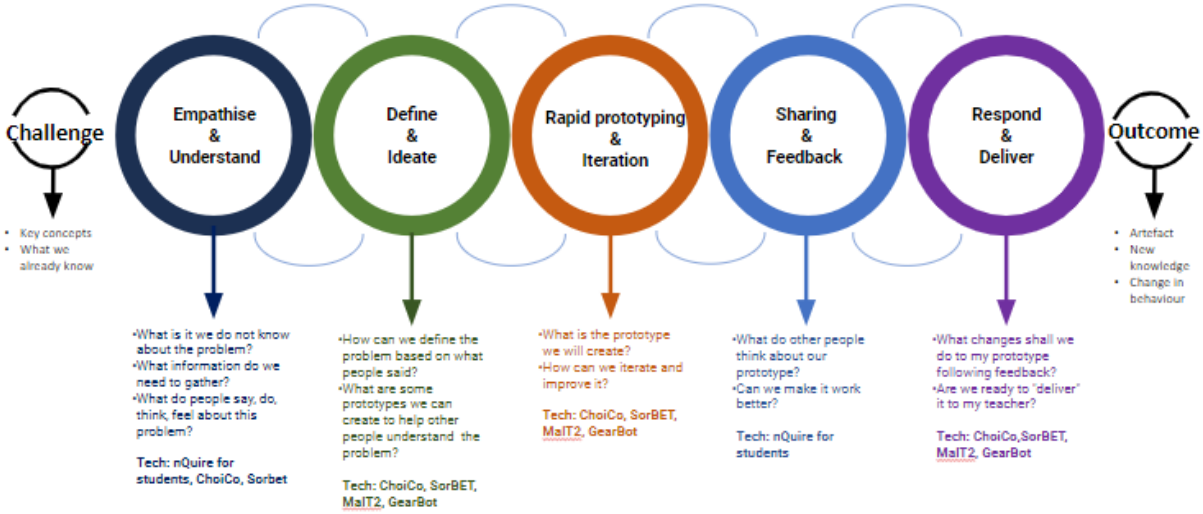
Grouping Criteria	mixed school performance, student preferences
Organisation	4 students per group using 1 device per group
Roles in the group	emergent roles; role exchange in the group
Tutor(s) role(s)	intervene; monitor; facilitate; guide; observe

2.4 TEACHING RESOURCES

Digital resources	Half baked ChoiCo game (The Beekeeper game) links to resources for bees and beekeeping
Physical resources	mini tutorial for ChoiCo design mode

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

One of the big issues related to environmental sustainability during recent years is the decline of bees' population. From pollinating human crops to playing a crucial role in the food chain, bees are essential for the ecosystem. Consequently, scientists emphasize the importance of protecting their population, and beekeepers are those who lead the way. Though having the best intentions, beekeepers face various difficulties in maintaining their beehives healthy and their bees happy. During this activity, students visit places where beekeepers can place their beehives taking into account bees' special needs and avoiding possible dangers that can endanger beehive wellbeing. Students first play the ChoiCo game "Beekeeper". Then they create a questionnaire for beekeepers in order to gather information on their opinion of the game. According to their answers, students define the main dangers beekeepers face. Following they visit places in their town (or near their town) in order to find spots where beekeepers can leave their beehives. During the development phase they modify the game "Beekeeper", adding the spots they believe are suitable and information about how to keep a beehive healthy. Finally they present their game to their peers as a tool to learn more about bees and to beekeepers as a tool for them to experiment with different spots and paths where they can move their beehives avoiding the danger of loosing them.

PHASE 1: EMPATHISE & UNDERSTAND

DURATION: 1 hours 15 min

DESCRIPTION OF THE ACTIVITIES:

During the 1st phase students explore supporting material (videos and links to sites selected by the teacher) in order to get familiar with beekeeper's needs and problems. Then they play the game "Beekeepers' game" and create a questionnaire using nQuire in order to gather their peers' and professional beekeepers' opinion about it.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics + NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS: Online questionnaire

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on what questions need to be included in the questionnaire
Between the groups	-same

PHASE 2: DEFINE & IDEATE

DURATION: 1 hours 15 min

DESCRIPTION OF THE ACTIVITIES:

Students discuss with their group interesting findings that may be useful for making their game more accurate and integrate into it useful information. They then decide on specific changes or additions they could integrate in the game in order to improve it.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics + NQuire ☐ No technology

Experiment with design mode in ChoiCo in order to test which modifications are applicable

STUDENT CONSTRUCTIONS: a list of 5 changes/additions in the game

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on which conclusions from the first phase are valuable and applicable
Between the groups	-

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 * 1 hours 15 min

DESCRIPTION OF THE ACTIVITIES:

Students design prototypes for their game, testing it internally in their group and redesigning it until a final version is ready. They constantly transit between play & design mode and save different versions of their game.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS: ChoiCo game prototypes

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	discussion and argumentation on which changes make the game better
Between the groups	-

PHASE 4: SHARING & FEEDBACK

DURATION: 2 * 1 hours 15 min

DESCRIPTION OF THE ACTIVITIES:

Students focus on (converge) their final solution and its delivery to the target audience They use nQuire, to create an online survey sharing their game with other students, teachers, beekeepers and asking them to evaluate it, giving them feedback. They also test other prototypes and give feedback (oral or written depending on the time left).

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics + NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	
Between the groups	Groups give feedback to each other and discuss ways the games can be improved further

PHASE 5:RESPOND & DELIVER

DURATION: 1 hours 15 min

DESCRIPTION OF THE ACTIVITIES

Students demonstrate their game by oral presentation. They explain the rationale behind their design and the changes they made to the original version. Finally they discuss the feedback they received in the previous phase in terms of what can be further improved and which points of the feedback find less important to take into account.

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 + ChoiCo ☐ SorBET ☐ VRobotics ☐ NQuire ☐ No technology

STUDENT CONSTRUCTIONS:

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion on further improvements
Between the groups	-same

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

Students' artifacts and teacher's notes

APPROACH

Learning Outcome	Assessment Activity
Recognize beehives' problems and needs	• pop up messages added in the ChoiCo game
Explain the suitability of a geographical location for beehives' wellbeing	• pop up messages added in the ChoiCo game • teachers' notes during discussions and delivery phase
Decide on places suitable for beehives	• values of choices in the ChoiCo game
Use geographical coordinates to refer to specific locations	• pop up messages added in the ChoiCo game • teachers' notes during discussions and delivery phase
Recognize the relationship between a geographical location and its climate conditions	• values of choices in the ChoiCo game • pop up messages added in the ChoiCo game • teachers' notes during discussions and delivery phase

Create different prototypes of ChoiCo games	
Interpret questionnaire answers to design criteria for the game they create.	• teachers' notes during discussions of define • lists of changes to be made in the game
Identify beekeepers' problems and beehives' needs	• pop up messages added in the ChoiCo game • teachers' notes during discussions and delivery phase • values of choices in the ChoiCo game
Relate the feedback from their peers and beekeepers to iterations they did to the prototype	• teachers' notes during discussions of define and sharing and feedback
Explain their ideas to others.	• teachers' notes during discussions
Present their final artifact by demonstration	• teachers' notes during deliver phase

Appendix S

SOLVING FAST FASHION DESIGN THINKING ACTIVITY PLAN YEAR 2

1. BASIC INFORMATION

PROJECT TITLE:

Solving Fast Fashion

AUTHOR(S):

TCD

ISSUE:

Fast fashion

FINAL STUDENT PRODUCTION:

A game or product, using MaLT2, ChoiCo, or SorBET, that will attempt to solve a fast fashion-related issue. The specific issue addressed in the final product will be identified by the students after they review responses from the nQuire survey.

TECHNOLOGIES TO BE USED:

✓MaLT2 ✓ChoiCo ✓SorBET ☐VRobotics ✓NQuire

2. FOCUS, SET UP & REQUIREMENTS OF THE ACTIVITY

2.1 LEARNING OUTCOMES

You can find the Learning objectives Verbs here

Domain Related	
Civic, Social & Political Education	Students should be able to create change in end-users' behaviours &/or attitudes towards fast fashion by accurately communicating relevant and current information on fast fashion
Computer Science	Students should be able to design a game or product using one emerging technology that attempts to solve a fast fashion-related issue
Design Thinking & innovation with Emerging Technologies Related	
Empathy	Students should be able to empathise with their end-users (local community) by creating 1 -2 questions that involve users' knowledge and/or emotions towards fast fashion
Experimentation	Students should be able to experiment and familiarise themselves with MaLT2, ChoiCo, and SorBET using a variety of already designed games, "half-baked" games and/or basic programming codes
Define	Students should be able to define a fast fashion-related issue in their local community by analysing and understanding results from the nQuire survey

Ideate	Students should be able to generate solutions with MaLT2, ChoiCo or SorBET to solve the fast fashion-related issue they identified
Rapid Prototyping & Iteration	Students will be able to create a prototype and make rapid changes to this prototype on one emerging technology
Sharing & Feedback; Respond	Students should be able to engage in peer feedback sessions and then respond to feedback by making appropriate changes to their prototype
Deliver	Students should be able to deliver a demonstration and oral presentation of their final solution and reflect on their thinking / learning processes throughout the DT project
21st century Skills Related	
	Communication; collaboration; creativity; time management; decision-making; computational thinking; reflection

2.2 PARTICIPANTS & CONTEXT

STUDENTS

Age	15 - 16
Prior knowledge	Knowledge of computer science and fast fashion industry, experience with Scratch and Micro:bit
Nationality, gender, cultural background	Irish; 12 boys/6 girls
Language	English
Special needs and abilities	3 – 4 non-native English speakers

TIME

ACTIVITY DURATION: 7 hours

IMPLEMENTATION DURATION: 7 weeks

SCHEDULE: 1 hour/week

SPACE

Specify where the activity will take place

ACTIVITY TYPE: ✓ In-person ☐ At distance ☐ Mixed

PHYSICAL SPACE: Computer lab

2.3 SOCIAL ORCHESTRATION

PEOPLE INVOLVED

NO OF STUDENTS: 18 NO OF GROUPS : 6 NO OF TUTORS: NO OF ASSISTANTS:

STUDENT GROUPING & INTERACTIONS

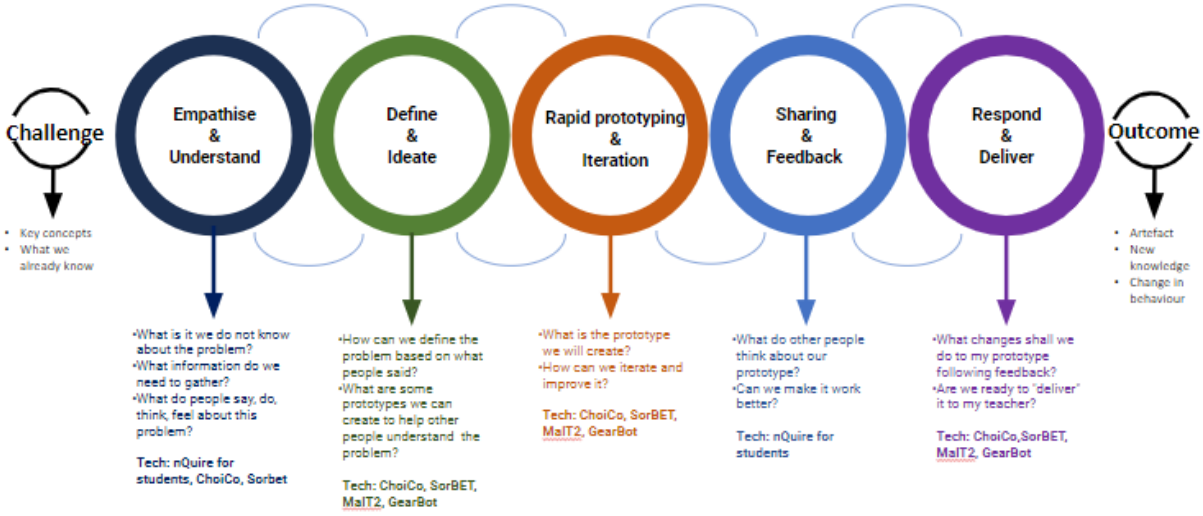
Grouping Criteria	Student preference
Organisation	3 students per group (each student has access to a computer)
Roles in the group	Emergent roles (6 sessions); assigned roles (1 session)
Tutor(s) role(s)	Intervene; monitor; facilitate; observe

2.4 TEACHING RESOURCES

Digital resources	Example games available on ExtenDT2 platform for ChoiCo and SorBET; technology manuals and how-to videos available on https://extendt2.eu/technologies/
Physical resources	Student worksheets for each session

3. IMPLEMENTATION - DESIGN THINKING ACTIVITY FLOW

This section describes how the teaching and learning process is expected to evolve through the 5 phases of the Design Thinking Methodology: 1. Empathise & Understand, 2. Define & Ideate, 3. Rapid prototyping & Iteration, 4. Sharing & Feedback, 5. Respond & Deliver. The described activities should support the objectives stated and make use of the technologies, supporting material, and teaching and learning processes mentioned earlier in the activity plan.



PHASE 0: CHALLENGE

Students will have the opportunity to explore a variety of fast fashion-related issues and create change in their local community's behaviour &/or attitudes towards fast fashion. Prior to this DT project, students learned about the negative consequences of fast fashion in CSPE (Civic, Social, and Political Education), including conditions workers in the garment industry face, environmental impacts of fast fashion production, etc. To address the project's overarching challenge, students need to know what their local community knows (or does not know) about fast fashion.

*The local community refers to other students in the school, friends, and family

PHASE 1: EMPATHIZE & UNDERSTAND

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In the "Empathise & Understand" phase students will create survey questions to get a better understanding of what their local community knows, thinks, or feels about fast fashion. This involves students empathising with their potential user, brainstorming questions for an online survey (nQuire) and finally distributing the nQuire survey to their local community. Each group will be responsible for submitting their "top" questions to the teacher, who will then compile these questions into nQuire to create a survey ready for distribution. Once the survey is finalised, students will use the link to share with family and friends.

- KWL chart on fast fashion
- Whole-class discussion on EMPATHISE
    - Examine different people involved and potentially impacted during the different stages of fast fashion
- Groups explore online resources on fast fashion provided by teacher to strengthen their knowledge of the issue
- Groups brainstorm at least 7 questions that could be used to find out what someone knows about fast fashion
    - "top" 2 questions will be submitted to teacher

Homework: students must ask 2 – 3 people to complete the online nQuire survey (via link)

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

☐ MaLT2 ☐ ChoiCo ☐ SorBET ☐ VRobotics ✓ NQuire ☐ No technology

STUDENTS' CONSTRUCTIONS:

a) KWL charts

b) Brainstorming evidence

c) 2 questions that address the end-users' knowledge and/or emotions of fast fashion

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Brainstorming and discussion of questions to be included in online survey
Between the groups	N/A

"SANDBOX" (EXPERIMENTATION) DAY

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

Although this is not a DT phase, this intervention includes a session solely for students to experiment with 3 technologies (MaLT2, ChoiCo, SorBET). To encourage student choice and empower students' creativity and decision-making, students will be given the opportunity to experiment and trial each technology. During this session, students will have 15 minutes to play on each software. Finished games, "half-baked" games and basic codes (for MaLT2) will be provided for students at the start of the session. Students will not be expected to construct anything during this session as we want them to engage in authentic play and discourage any eager students from rushing ahead to create a solution. Teacher & researcher will gently remind students that the purpose of experimenting is so they have an idea of what the 3 technologies can do when they are brainstorming solutions later, but they are NOT to create a solution in this session.

- Provide feedback to students on their survey questions from last week
    - Identify great vs. not-so-great questions & discuss how to improve not so great questions to get a better idea sense of user needs
- Experiment with 3 technologies
    - Become familiar with what the software can do
    - What do you like? What don't you like?

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

✓MaLT2 ✓ChoiCo ✓SorBET ☐VRobotics ☐NQuire ☐No technology

STUDENT CONSTRUCTIONS:

N/A

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Commentary / opinions on technologies; questions if student is confused or unsure how to use technology
Between the groups	N/A

PHASE 2: DEFINE & IDEATE

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In the "Define & Ideate" phase, students will identify an issue within their local community based on the survey results and generate possible solutions with the project's technologies. First, students will have to analyse the results from the nQuire survey to see what their local community knows, thinks or feels about fast fashion. This review and synthesis of survey data will allow students another opportunity to empathise with / understand their end-users and encourages an explicit connection between the students' local community and the issue they will attempt to solve. As students are analysing the survey data, they will identify one issue that feels relevant to them and wish to focus on

for their project. Students will define this issue through a "How Might We" question, a common approach to defining issues as cited by relevant DT literature. Finally, students will brainstorm possible solutions with the project's technologies to their "How Might We" questions. By the end of the session, groups are expected to select one solution and a technology to begin prototyping with.

- Discuss and analyse nQuire survey results
- Define one issue to tackle for your project based on survey results
    - What does your community know (or not know) about fast fashion?
    - How does your community feel about fast fashion?
    - Does your community need anything that might minimise the impacts of fast fashion?
- Create a "How Might We" Question to outline the issue your group wants to solve
    - Example: 'How might we encourage community members to adopt reusable alternatives for everyday items like bags and containers?"
- Ideate solutions with ALL 3 technologies to answer the "How Might We" question

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

- Students will explore results from the nQuire survey
- Students may also revisit the 3 technologies (MaLT2, ChoiCo, SorBET) on the ExtenDT2 platform as they are ideating solutions

STUDENT CONSTRUCTIONS:

a) A written "How Might We" question

b) Written brainstorming of possible solutions with the technologies to answer "How Might We" question

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion of what the nQuire survey results mean; Discussion and argumentation of what issue to focus project on; Brainstorming and discussion of possible solutions for their issue
Between the groups	N/A

PHASE 3: RAPID PROTOTYPING & ITERATION

DURATION: 2 hours

DESCRIPTION OF THE ACTIVITIES:

In the "Rapid Prototyping & Iteration" phase, students will begin creating their game or product on a project's technologies (MaLT2, ChoiCo, SorBET). Students will start with the solution they came up with from the previous class and use the technology to "bring it to life." The teacher and researcher will encourage students to have a rough sketch of their idea's crucial elements on paper to maintain focus

and prevent students from spending too much time on one aspect or functionality. The ExtenDT2 platform will support students to test out their game and make changes to it as ChoiCo and SorBET allow for a quick transition between play & design modes.

- Whole-class discussion on "prototype"
    - What is a prototype?
    - Why is it important in DT?
    - How to prototype?
- Assign group roles & establish times for rotation of roles between group members
    - Computer controller: manages & uses software to create game / product
    - Computer assistant: keeps a close eye on the computer controller to make sure information is correct & to see if anything should be added or changed
    - Recorder: observes group, contributes to iteration of game / product & records important changes made with technology
- Students develop prototypes on technology and record what they did, different variations they tried, challenges faces, new ideas, etc.
    - Worksheet provided
- Reminders to test out game if using ChoiCo or SorBET by pressing "Play"
    - Encourage students to reflect on the prototype … What works? What does not?

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

✓MaLT2 ✓ChoiCo ✓SorBET ☐VRobotics ☐NQuire ☐No technology

STUDENT CONSTRUCTIONS:

a) Prototype on selected technology

b) Written records of changes / edits made to prototype

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion and argumentation of prototype; discussion of group roles; reflection on prototype; suggestions for changes to prototype
Between the groups	Support with using the technology; piggybacking off each other's ideas; potential feedback

PHASE 4: SHARING & FEEDBACK

DURATION: 1 hour

DESCRIPTION OF THE ACTIVITIES:

In the "Sharing & Feedback" phase, students will demonstrate their prototype to another group and then participate in both sides of feedback (giving / receiving). Groups will be paired off for the peer review sessions and will have the support of a feedback card / rubric to ensure feedback is relevant and meaningful. After the peer review sessions, groups will go back to their prototype, plan out their final steps and make appropriate changes to their game / product based on the feedback received. Students will also be encouraged to spend time preparing for their final presentation of their solution.

- Review prototype from last class & provide opportunity to record iterations made
- Peer review sessions
    - Introduction of feedback cards / rubric
    - Group A gives demonstration & Group B provides feedback
    - Group B gives demonstration & Group A provides feedback
- Final workshop for prototypes
    - Students reflect on feedback & discuss final steps so that their solution is completed by the end of class
        - Students estimate time to complete steps & assign timekeeper
    - Students follow outline & make final changes to game / product
- Review rubric for final presentation so students know criteria for success

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

✓MaLT2 ✓ChoiCo ✓SorBET ☐VRobotics ☐NQuire ☐No technology

STUDENT CONSTRUCTIONS:

a) Completed feedback cards

b) Plan of final steps to complete project with estimated time

c) Final version of game / product submitted to teacher via ExtenDT2 platform

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Discussion of final steps; reflection on feedback; collaboration for final game improvements
Between the groups	Providing & receiving feedback

PHASE 5: RESPOND & DELIVER

DURATION: 30 minutes - 1 hour

DESCRIPTION OF THE ACTIVITIES:

In the "Respond & Deliver" phase, students will present and demonstrate their final product to the class, teacher and researchers. Students will demonstrate their solution through a class presentation and will be assessed on whether they include the following:

- A problem identified from survey results
- A demonstration of the solution created with a project technology
- An overview of the group's process when designing and iterating the solution, including how you responded to the feedback given

  ➢ Group presentations

    - Each group will have 3 – 5 minutes to give a demonstration of their game, provide relevant information as suggested by the rubric & answer any questions

EXPECTED USE OF EXTENDT2 TECHNOLOGY:

✓MaLT2 ✓ChoiCo ✓SorBET ☐VRobotics ☐NQuire ☐No technology

STUDENT CONSTRUCTIONS:

a) Presentation of final solution on project technology

STUDENTS' EXPECTED INTERACTIONS:

Between the members of the group	Collaboration for product demonstration & oral presentation
Between the groups	Active engagement with other groups' demonstrations & presentations

4. STUDENT ASSESSMENT AND FEEDBACK

TOOLS

- Group worksheets for each DT phase
- Final games / products
- Final presentations
- Observation notes from researcher & teacher

APPROACH

Learning Outcome	Assessment Activity
Empathise with their end-users (local community) by creating 1 -2 questions that involve users' knowledge and/or emotions towards fast fashion	• Written 1 – 2 questions to be included in nQuire survey (student worksheet)

Experiment and familiarise themselves with MaLT2, ChoiCo, and SorBET using a variety of already designed games, "half-baked" games and/or basic programming codes	• Learning analytics from ExtenDT2 platform • Discussion of student opinions and experiences using 3 technologies
Define a fast fashion-related issue in their local community by analysing and understanding results from the nQuire survey	• Written "How Might We" question with direct connection to issue identified (student worksheet) • Presentation
Generate solutions with MaLT2, ChoiCo or SorBET to solve the fast fashion-related issue they identified	• Evidence of brainstorming (student worksheet) • Brainstorming discussion(s)
Create a prototype and make rapid changes to this prototype on one emerging technology	• Prototype on emerging technology • Written record of iterations made (student worksheet)
Engage in peer feedback sessions and then respond to feedback by making appropriate changes to their prototype	• Feedback cards (student worksheet) • Reflection on changes made to prototype based on feedback received (presentation)
Deliver a demonstration and oral presentation of their final solution and reflect on their thinking / learning processes throughout the DT project	• Final oral presentation of product / game to class, teacher & researcher